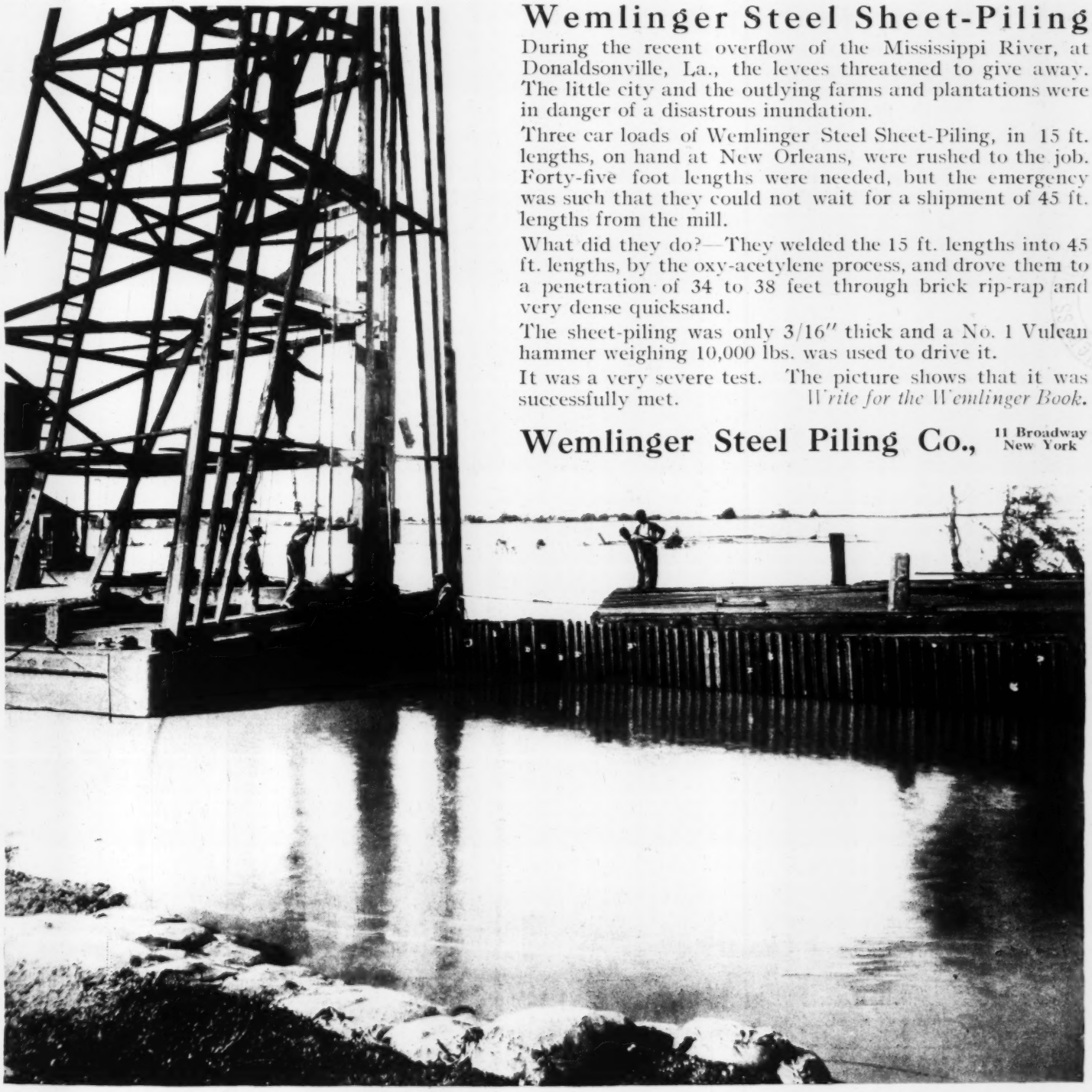
MAY 16 1913

Engineering News

NEW YORK, MAY 15, 1913

The State of Louisiana Saving A Mississippi Levee with



Wemlinger Steel Sheet-Piling

During the recent overflow of the Mississippi River, at Donaldsonville, La., the levees threatened to give away. The little city and the outlying farms and plantations were in danger of a disastrous inundation.

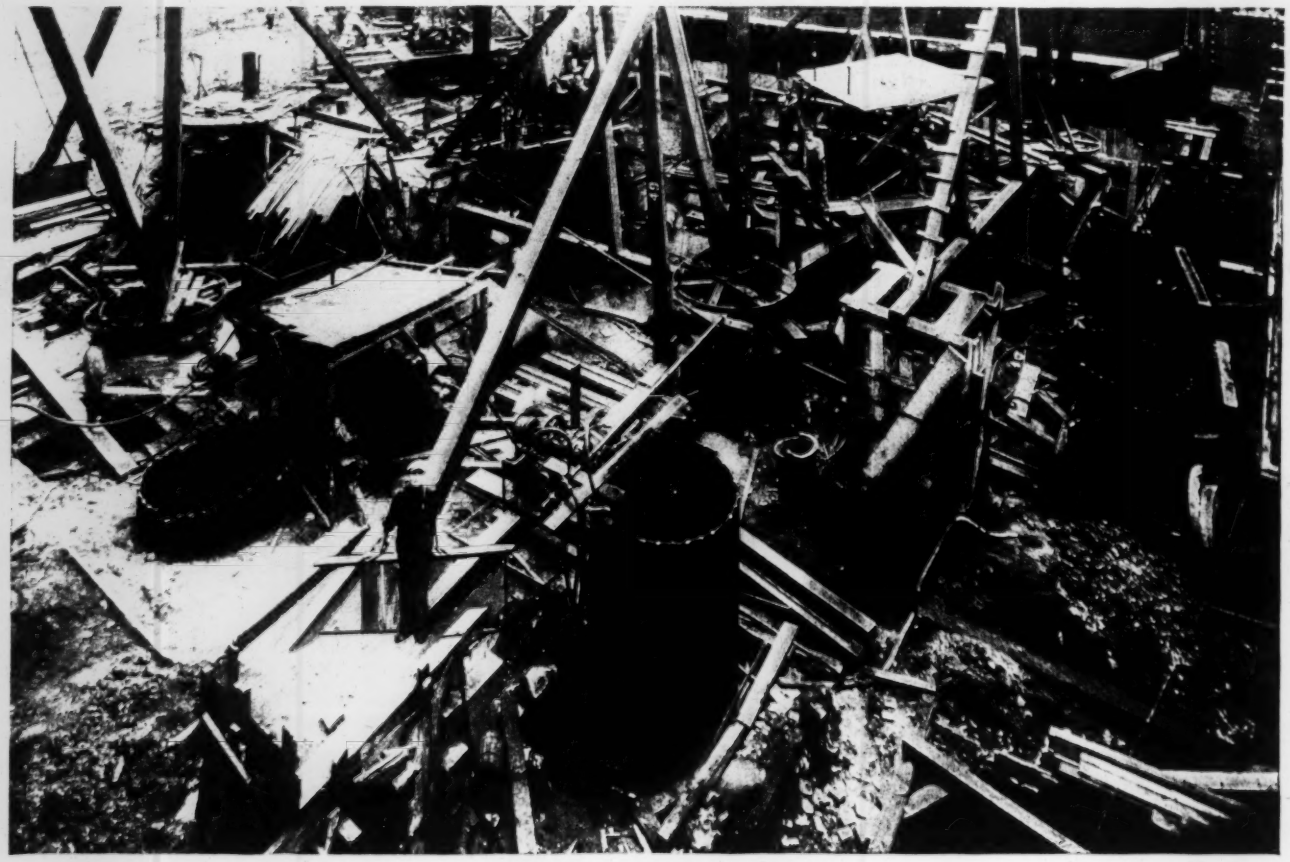
Three car loads of Wemlinger Steel Sheet-Piling, in 15 ft. lengths, on hand at New Orleans, were rushed to the job. Forty-five foot lengths were needed, but the emergency was such that they could not wait for a shipment of 45 ft. lengths from the mill.

What did they do?—They welded the 15 ft. lengths into 45 ft. lengths, by the oxy-acetylene process, and drove them to a penetration of 34 to 38 feet through brick rip-rap and very dense quicksand.

The sheet-piling was only 3/16″ thick and a No. 1 Vulcan hammer weighing 10,000 lbs. was used to drive it.

It was a very severe test. The picture shows that it was successfully met. *Write for the Wemlinger Book.*

Wemlinger Steel Piling Co., 11 Broadway New York



Circular open Caissons of Lackawanna Steel Sheet Piling for Foundation Piers of the Kinney Building, Newark, N. J.

Forty-five circular and rectangular open caissons extending over 50 feet below the curb were required for the foundation piers of this 96 by 96 foot 12-story building. Some of the circular caissons, which varied from 6 feet to 7 feet 9 inches in diameter, are shown.

The general excavation extended 16 feet below the curb, and pits of 4 to 10 feet further depth were excavated for the pier foundations and sheeted with square-edged 2-inch planks. On the bottoms of the pits were assembled the caissons of Lackawanna Steel Sheet Piling in 25 to 30-foot lengths. At 25 feet below curb, there was an abundance of ground water and quicksand down to hardpan at a depth of 35 to 40 feet. The hardpan consisted of cemented gravel and hard boulders but the Lackawanna piling penetrated without difficulty.

This piling was assembled by derricks and tightly clamped together by outside wire cables, and driven by 1500-lb. hammers, each operated by four men and driving a caisson in about five hours. The interior would then be excavated to $2\frac{1}{2}$ feet below the piling bottoms and the piling further driven to bottom of excavation in about $\frac{3}{4}$ hour.

After a pier was completed, the Lackawanna piling was withdrawn and reused. This was found quite practical as the piling was found to be in splendid condition. Further data and evidence of satisfaction from the Lackawanna Steel Sheet Piling will be given in next week's advertisement. Watch for it, and in the meantime, send for our literature.

LACKAWANNA STEEL COMPANY

General Sales Office and Works: Lackawanna, N. Y.

NEW YORK BOSTON BUFFALO PHILADELPHIA CLEVELAND CINCINNATI CHICAGO DETROIT ST. LOUIS ATLANTA SAN FRANCISCO

72

Engineering News

CHARLES WHITING BAKER, *Editor*

Subscriptions payable in advance, $5.00 a year for 52 numbers, including postage in the United States, Mexico, Cuba, Porto Rico, Hawaii, or the Philippines, $7.50 in Canada.

Published Weekly By HILL PUBLISHING COMPANY

505 Pearl Street, New York, N. Y.

JOHN A. HILL, Pres. ROB'T MCKEAN, Sec'y.

Cable Address: "ENGNEWS"

To foreign countries, including postage, $9.00 or its equivalent, 36 shillings; 36 marks; or 45 francs. Notice to discontinue should be written to the New York Office in every instance. Advertising copy should reach New York Office by Thursday of week before date of issue. Entered at New York Post-office as mail matter of the second class.

VOLUME 69 MAY 15, 1913 NUMBER 20

CONTENTS

WITH PRINCIPAL ARTICLES SUMMARIZED

*Illustrated Article

*CONSTRUCTION OF THE KACHESS DAM, WASHINGTON: *Page* 989

Complete and fully illustrated account of the construction of an earth dam 65 ft. high and 1400 ft. long built across the Kachess River by the U. S. Reclamation Service; reinforced-concrete conduit; intake tower; construction methods. 10,000 w. 11 ill. E. H. Baldwin. ENGINEERING NEWS, May 15, 1913.

AN OPPORTUNITY AND A PURPOSE FOR A LOCAL ORGANIZATION OF A NATIONAL ENGINEERING SOCIETY: *Page* 999

Extract from the presidential address to the San Francisco Association of Members of the American Society of Civil Engineers. 1000 w. Chas. B. Wing. ENGINEERING NEWS, May 15, 1913.

*MECHANICAL OIL BURNERS: *Page* 1000

Abstract of a paper presented before the Society of Naval Architects and Marine Engineers; describes oil burners which spray by mechanical means without the use of steam or compressed air. 2500 w. 4 ill. E. H. Peabody. ENGINEERING NEWS, May 15, 1913.

*AIR AS A STIMULATOR OF CORROSION IN REFRIGERATING SYSTEMS: *Page* 1002

Describes results of experience and tests showing the accelerated corrosion of metal from air-saturated brine in refrigerating systems; practical data for the proper design of such equipment to prevent danger of rapid corrosion; supplementing article in "Engineering News" of Feb. 13, 1913, on "The Design of Hot-Water Supply Systems." 1600 w. 1 ill. M. B. Smith. ENGINEERING NEWS, May 15, 1913.

*SMOKE-WASHERS FOR ROUNDHOUSES: *Page* 1004

Describes plant put in service by the Lake Shore & Michigan Southern Ry., at the Englewood (Chicago) roundhouse; reducing the locomotive-smoke nuisance in cities by washing the smoke discharged from locomotives in roundhouses. 1000 w. 3 ill. ENGINEERING NEWS, May 15, 1913.

WASHINGTON WORKMEN'S COMPENSATION ACT AND THE RESULTS OF ITS FIRST YEAR OF ADMINISTRATION: *Page* 1005

Gives important provisions of the act which went into operation in the State of Washington on Oct. 1, 1911; insurance cost to employers; number of pensioners; appeals; nonhazardous class protection, etc. 3000 w. L. R. W. Allison. ENGINEERING NEWS, May 15, 1913.

COST OF IRRIGATION WORKS PER ACRE SUPPLIED WITH WATER: *Page* 1008

Tables showing cost water right per acre on various private irrigation projects; acres in each project; cost of water right per acre on Carey Act irrigation projects; acres in each project; cost and acreage of U. S. Reclamation Service projects; settlement on irrigation tracts, conditions of payment, etc. 3000 w. ENGINEERING NEWS, May 15, 1913.

*DECREASE OF COAL-MINE ACCIDENTS IN THE UNITED STATES: *Page* 1009

Diagram showing death rates in coal mining for years 1896 to 1912. 500 w. 1 ill. ENGINEERING NEWS, May 15, 1913.

*CITY WATERWAY BRIDGE, TACOMA, WASH.: *Page* 1010

Description of new lift drawbridge of the Waddell & Harrington type, consisting of a simple truss span suspended at the four corners by wire ropes; 220-ft. vertical lift span with 60-ft. clearance at high tide with span down and 135 ft. with span up. 1000 w. 2 ill. ENGINEERING NEWS, May 15, 1913.

*RAILWAY VALUATION BOARD OF THE INTERSTATE COMMERCE COMMISSION: *Page* 1019

Biographical sketches and portraits of the five engineers who are to have charge of the tremendous task of making a valuation of all the property of all the common carriers in the United States doing an interstate business. R. A. Thompson; W. D. Pence; J. S. Worley; H. M. Jones; E. F. Wendt. 1000 w. 5 ill. ENGINEERING NEWS, May 15, 1913.

*TYPHOID OUTBREAK AT ALBANY, N. Y., DUE TO FLOODED FILTERS: *Page* 1021

Describes typhoid fever outbreak at Albany in April, 1913; an interesting and striking example of an explosive epidemic due to a sudden, and in some respects, accidental infection of the water supply, resulting from the flooding of the slow sand-filtration plant. 3000 w. 1 ill. Theodore Horton. ENGINEERING NEWS, May 15, 1913.

CITY PLANNING CONFERENCE AT CHICAGO: *Page* 1024

Report of the Chicago conference. 1000 w. ENGINEERING NEWS, May 15, 1913.

DEDICATION OF NEW BUILDING AT THE UNIVERSITY OF ILLINOIS: *Page* 1024

Report of the dedication exercises of the new transportation building. 700 w. ENGINEERING NEWS, May 15, 1913.

EDITORIAL: *Page* 1011

LETTERS: *Page* 1013

ENGINEERING NEWS OF THE WEEK: *Page* 1026

PERSONALS: *Page* 1027

ENGINEERING SOCIETIES: *Page* 1028

ENGINEERING LITERATURE: *Page* 1029

CONSTRUCTION NEWS: *Page* 43

CONTRACTS TO BE LET: *Page* 65

WANT ADVERTISEMENTS: *Page* 71

ADVERTISING INDEX: *Page* 128

CIRCULATION OF THIS NUMBER OF ENGINEERING NEWS 20,000

None sent free regularly, no returns from news companies, no back numbers

What The Buyer Needs To Know

Number Twenty

Down in the basement of the Woolworth Building the painters are finishing the decorations of the walls, the ladders and scaffolding stand around ready to be carted away, in the hall a man in brown livery, running over a file of index cards, answers questions about the tenants, for the wall directory is not yet ready.

The entrance halls and lobbies are crowded with throngs of the curious—men, women and children—some of whom are obviously sightseers from out of town. And down in the new German restaurant in the basement with its paneled gilded ceiling there are other sightseers gazing around them curiously, some of them thinking, perhaps, with a little thrill of awe, that over them, towering into the blue spring sky, stand fifty-five stories of steel and concrete.

For the Woolworth Building is at last finished and the fame of it has traveled to the four corners of the earth. The highest building in the world—the best advertised!

Think of the many pictures you have seen of it, and of the descriptions you have read of it. Every manufacturer who has had his product used in its construction has, it seems, advertised the fact.

Marvelous as the Woolworth Building is, it is no more marvelous than the power of publicity which everywhere has made it known so quickly and so well.

Here in a few years a building has become as famous as those buildings which we have all heard of from our childhood—the Coliseum in Rome, Notre Dame in Paris, Westminster Abbey and the Tower in London.

In three or four years through the medium of ink and paper this new building becomes as familiar to you as those buildings which have slowly gained their fame through the centuries.

In America, at least, we have a more definite picture before our eyes when we think of the Woolworth Building than when we think of the others.

Just as the Woolworth Building has been advertised, so various commercial products have been advertised. Consider how long it would have taken the automobile to come into general use if the knowledge of it were limited to the old methods of word-of-mouth. The pleasure and convenience that thousands of people are deriving from barren shore, their automobiles would have been denied them for years.

Advertising is the great Voice of Modern Commerce. It enables Commerce to make its message universal, it reaches the tiniest hamlet, it goes to every bleak and it mingles every day with the people of the great cities.

Advertising is everywhere.

The good it does cannot be measured by mere dollars and cents.

Advertising brings comfort and convenience and happiness and economy where otherwise they might be unknown.

Engineering News

VOLUME 69 MAY 15, 1913 NUMBER 20

Construction of the Kachess Dam, Washington

By E. H. Baldwin*

SYNOPSIS—The author has presented an unusually complete and well illustrated account of the construction of an earth dam 65 ft. high and 1400 ft. long, built by the U. S. Reclamation Service across the Kachess River, a short distance below the lake of the same name, to increase the storage capacity of the lake for irrigation purposes. Features of the work were the dredging of a channel from deep water in the lake toward the dam, the construction of a reinforced-concrete conduit from the lower end of the dredged channel to a point near the dam; an intake tower; a reinforced-concrete conduit through the dam; a spillway far to one side; the use of dump cars and a high trestle for bringing the earth to the embankment; and the use of a high timber concrete elevating tower in building the outlet tower.

Ultimate irrigation development in the valley of the Yakima River, Washington, by the United States Reclamation Service will require the storage of practically all the runoff tributary to the Yakima River. Present irrigation requirements necessitate the storage of a large portion of the runoff to supplement the natural flow of the river from June 15 to Oct. 1, approximately. Nature has fortunately provided, on the easterly slope of the Cascade mountains, a number of natural reservoirs in the form of lakes, the three larger of which are Lakes Cle Elum, Kachess and Keechelus, having at their normal elevations a combined surface area of 7,500 acres and being supplied by a drainage area of 325 sq.miles. The mean annual runoff from this drainage area for the past eight years is 1,120,000 acre-feet. Near the lower end of these lakes the United States Reclamation Service contemplates the construction of storage dams that will impound or make use of the entire runoff. One of these dams, at Lake Kachess, is practically completed and work preliminary to the construction of a dam at Lake Keechelus was commended in August of this year.

Lake Kachess is the middle lake of the three. It is very regular in shape, about ten miles long, and has a maximum width of one mile. It is situated in the Wenatchee National Forest and discharges, through the Kachess River, into the Yakima. The mean annual runoff from its drainage area of 63 sq. miles, based on records for eight years, is 209,000 acre-feet. The maximum recorded runoff in 1909-10, was 277,000 acre-feet. The capacity of the completed reservoir is 210,000 acre-feet.

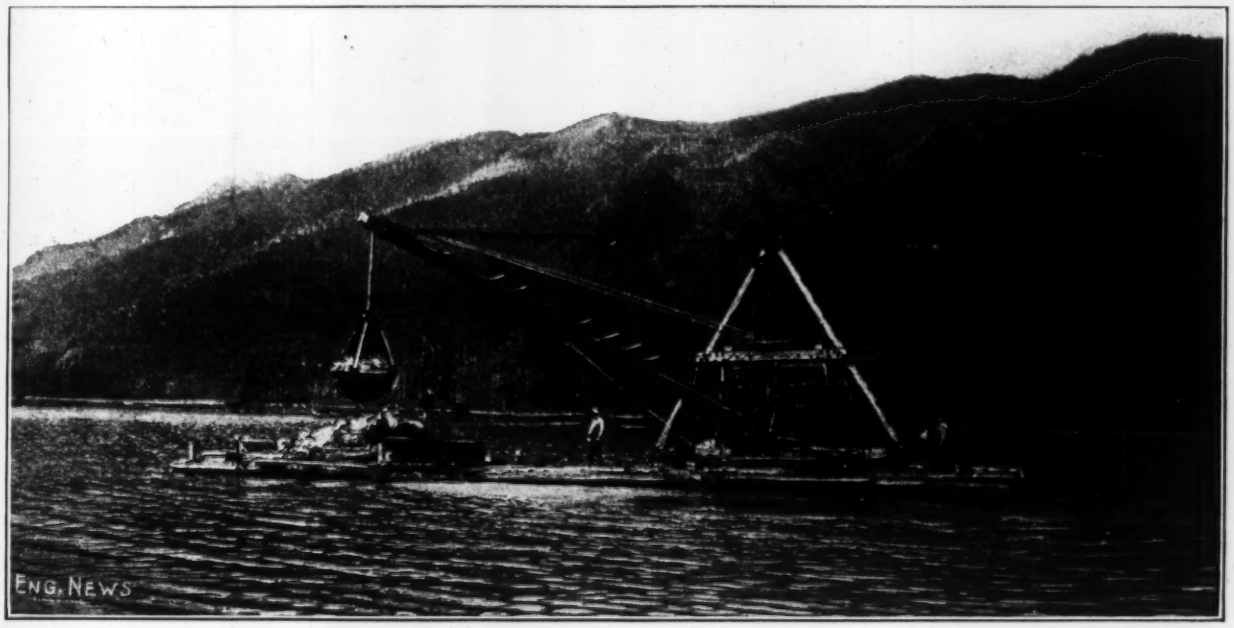


Fig. 1. Orange-Peel Dredge Digging Lake-Outlet Channel above Kachess Dam, Yakima Irrigation Project, Washington

The Kachess River is very crooked, making four complete bends in a distance of two miles, but progressing only 2800 ft. in a straight line from the lake. The river drops some 35 ft. in the two miles. The irregular course of the river afforded an excellent opportunity for handling it during construction and the depth of

*Construction Engineer, U. S. Reclamation Service; now at Elephant Butte, N. M.

the lake and rapid fall of the river, within a reasonable distance, suggested the feasibility of tapping the lake at an elevation about 30 ft. below its normal outlet, thereby giving some 76,000 acre-feet of sub-storage.

The Kachess Dam is built across the Kachess River, about 1800 ft. below the most southerly point of the lake (Fig. 2). It is of the earth and gravel type, 65 ft. high and 1400 ft. long. Its crest is at Elev. 2268 and has a top width of 20 ft. The upstream slope of the dam is 3 to 1 and the downstream slope 2 to 1. To prevent percolation a wide cutoff trench about 20 ft. deep was excavated paralled with the axis of the dam and from 20 to 60 ft. upstream from the center line. In the bottom of this trench a narrower trench was excavated to a depth of from 35 to 75 ft. below the original ground surface and in it a concrete core-wall, 2 ft. thick, was built, extending up to the original surface of the ground.

Accessory features are the outlet works and spillway. The outlet works consist of an open channel about 1200 ft. long, extending from deep water in the lake to a point where a covered conduit was found to be more economical. This conduit is of reinforced concrete, about 1400 ft. long, horse-shoe type, 9x10 ft., and discharges into a paved open channel of large section, about 300 ft. long, immediately in front of the dam.

The conduit through the dam is of reinforced concrete, also of the horse-shoe type, 12x12 ft. in cross-section and 300 ft. long. It discharges into a paved open channel about 500 ft. long which empties into the Kachess River. The flow is controlled by three sets of two sluice gates, each 4x10 ft., placed at the intake of the dam conduit and operated by power from the gate tower. The maximum capacity of the outlet works is 5,000 cu.-ft. per sec.

The spillway, which is constructed at a low point in the rim of the reservoir one-half mile east of the dam, has a crest length of 250 ft. and is designed to carry 7,200 sec.ft., with a head on the weir of 4 ft. The elevation of the weir is 2258, with provision for 2 ft. flash boards.

Construction of the dam was authorized in February, 1910, and actual work commenced two months later. The first season's work was intended to be preliminary to the main development and was primarily to obtain, at the earliest possible date, additional storage of about 40,000 acre-feet. With this idea in view the 1910 work contemplated the partial dredging of a channel from the lake, the construction of a temporary dam with temporary control at the intake of the small conduit and the diversion of the river preliminary to the construction of the outlet works. It was intended to let the balance of the work by contract but the proposals received were rejected and the entire work was done by force account at a cost considerably less than the price of the lowest bidder.

Clearing, grubbing and stripping of the different areas were carried on intermittently, as proved to be necessary and convenient. The clearing and grubbing were unusually heavy. The areas were first swamped over, the brush and down stuff piled ready to burn; then trees under 12 in. were cut and stored for construction purposes. The larger timber was mainly used for fuel. Powder was freely used in removing the larger stumps, the smaller ones generally being pulled by a donkey engine, which was also used in piling for burning. At the spillway the timber was generally small and all grubbing was done by teams. Stripping was mainly confined to the dam-site, from the entire area of which all soil and vegetable matter were removed. In the upstream portion of river section all coarse material was removed to a depth of several feet.

Excavation for Outlet from Deep Water in Lake

One of the most interestaing possibilities of the work was that of obtaining additional storage capacity by placing the outlet at the lowest feasible elevation. At the time of commencing operations a low crib dam at the lake outlet controlled the lake between the gate sill, Elev. 2226, and what was considered a safe storage limit, Elev. 2231.5, thus impounding water to a depth of 5.5 ft., which furnished storage capacity for 16,000 acre-feet. The economical depth to which the lake could be feasibly drawn was governed by the course and grade of the river below the proposed dam. It was found impracticable to

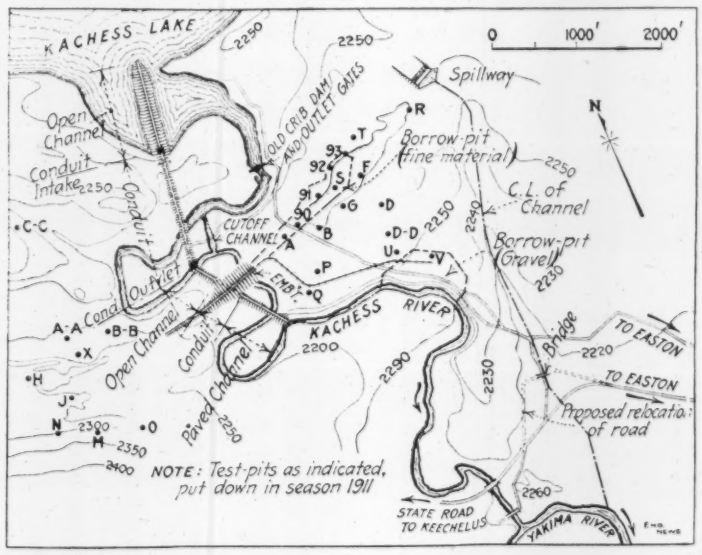


Fig. 2. General Plan of Kachess Dam and Vicinity

carry the outlet works below Elev. 2190, on account of the flat grade of the river beyond this point, which is about 4000 ft. distant from deep water in the lake. To obtain sufficient grade to discharge an amount equal to the minimum irrigation demand of 400 sec.ft. from this lake, the bottom of the dredged channel was placed at Elev. 2194. This permits of drawing the lake surface down to Elev. 2200, at which elevation it will discharge the required flow.

After clearing and grubbing operations were sufficiently advanced team work was started at the lake end of the outlet works, excavating material from the intake and using it in constructing a coffer dam to hold back the lake while the first 200 ft. of conduit, temporary dam and temporary control works were being constructed. While this work was in progress equipment was being received and erected. To excavate the material in the lake an orange-peel dredge was used; the balance of the excavation for outlet trenches was done with teams, steam shovel and drag-line excavator.

Numerous soundings in the lake bottom indicated that a grab-bucket dredge would be suitable for excavating this material and as the project owned the essential parts of an orange-peel skid excavator it was decided to use

this machine. A raft about 30x60 ft. was built of cedar logs, from 2 to 4 ft. at the butt, tied together with 12-in. cross logs, and on it was bolted the skid excavator (Fig. 2). For handling the material two bottom dump scows were made. These scows were built with a center compartment, with doors in the bottom held up by chains winding on a shaft which has a dogging device to hold the load. When ready to dump the dog is knocked out with a hammer and the load falls through the bottom. For operating the scows a 30-ft. gasoline launch with a 25-hp. engine was used. The haul for the scows was from 1000 to 2000 ft. and it took from 20 to 30 minutes to make the round trip.

The dredged channel is about 1000 ft. long. Its bottom is from 30 to 35 ft. below normal water surface and the depth of excavation was about 27 ft. It has a bottom width of 12 ft. and side slopes of 3 to 1. The material is a blue clay, soft and oozy on top and gradually growing dryer and harder with the depth.

At the outer end of the channel there was a ridge covered with several feet of loose boulders, many of which had to be broken with powder. It was found necessary to drill and blast the greater portion of the clayey material. A 3-in. well drill was first tried but was unsuccessful. It was then found that the material could readily be bored with an auger, after driving a casing ahead.

In putting down a hole a piece of 3-in. casing about 3 ft. longer than the depth of water was driven to within 1½ ft. of the water surface. The material was then bored out to the required depth with augers attached to ¾-in. pipe of convenient length and turned with Stillson wrenches, which were also used to lift the auger to clean it. As the holes would not stand any length of time it was necessary to load them soon after they were finished; they were generally from 16 to 24 ft. deep and 20 to 25 ft. apart. About one box of 20% stumping powder was used in each hole. The holes were not sprung and great care was necessary to get the powder to the bottom of the hole, as it had a tendency to float up. Water tamping alone was used and from one to four holes were set off at once. The blasting was very effective, more than doubling the output as compared with excavation before blasting in the same location.

The total volume removed by dredging was 105,000 cu.yd. With the exception of a short time during the season of 1911 one shift only was used. In fair digging the output for an 8-hr. day was 500 cu.yd., the maximum being 630 cu.yd. The output was at times erratic on account of high wind and rough water or the necessity of working against a strong current when releasing storage water. The cost of drilling and shooting this material was close to 4c. per cu.yd. of total excavation.

The intake and trench for the small conduit, from the lake to the open channel in front of the dam, was practically all excavated with a Lidgerwood-Crawford drag-line excavator. This work was commenced Sept. 26, 1910, carried with three shifts and during that season completed between the coffer dam and Sta. 14-00. The intake excavation was somewhat difficult, as the material at the lake end and sides was mainly a plastic blue clay, similar to that in the lake bed, and was removed during the rainy season. It was intended to carry a portion of the excavation to a 2 to 1 slope but on account of the oozy material and wet weather much of it assumed a much flatter slope and at times it was difficult to prevent the machine from sliding with it. At the intake, where concrete was to be placed, it was necessary to put in considerable heavy crib-work to hold the material. The grade of the intake was 36 ft. below the lake level and water came in so freely that an 8-in. centrifugal pump was kept going continuously to handle it. In order to have the temporary dam and control works on a suitable foundation it was necessary to place them some 80 ft. south of the point originally selected.

The soft material gave out a short distance from the lake and beyond that point the trench material was all that could be desired, so far as sliding was concerned. In digging the trench the excavator was kept on the center line, digging from the end and dumping to either side. On account of the deep cutting, from 30 to 55 ft., the machine was fitted with a 70-ft. boom, but this was not sufficient in the deeper cuts. The trench was taken out to a bottom width of about 15 ft., with slopes as steep as they would stand. The material was a cemented gravel, containing a comparatively small amount of clay, but so firmly cemented that in places the sides would stand almost vertical, even with water dripping over them, and so hard that it was necessary to loosen the entire cut by blasting.

The drilling was done with a 3-in. Cyclone well drill. Three rows of holes were put down, the row through the center being carried to grade, while the rows on either side of center line and about 20 ft. from it were only carried about half-way down. The center shots loosened the bottom and the side shots the upper material sufficiently to enable the excavator to remove it to a slope that was safe to work under. Many of the holes were put down to a depth of 48 ft. The total depth of drilling was 2000 lin. ft. The cost of drilling was 57c. per lin.ft. of hole and the cost of drilling and blasting 4.4c. per cu.yd. of material.

In excavating the deeper portion of this cut great difficulty was experienced in disposing of the material and in taking out the bottom five feet. The excavation was made in one cut, the machine working from the end, but to dispose of the material necessitated the construction of crib work at the edges of the trench to retain the material thrown out, and it was further necessary to sluice the excess material back from the edge. It was found that the finer material could be sluiced to a 7 to 1 slope. On account of considerable water in the cut, necessitating pumping at all times, the dragging of the bucket over the bottom would stir the material up into a thick mud that would neither pump nor remain in the bucket at the angle incident to such deep cutting. Various schemes were tried but the most successful seemed to be to leave about five feet in the bottom until the machine had gone ahead several hundred feet, then, with the aid of a haul-back fastened at the temporary dam, to drag this material into a pile directly in front of the excavator, allow the water to drain from it and throw it out. Fig. 3 shows the machine dragging the bottom. For cuts of 40 ft. or less there was no trouble in digging or disposing of the material when it it was sufficiently shot. The daily output of the machine on this work was small on account of the depth of cutting and other difficulties mentioned. The length of this trench was 1400 ft. and from it were taken 85,000 cu.yd. of material. When the excavator reached the open channel, near Sta. 26, it removed the wide upper part of the

cut, leaving the deep and narrow excavation for the steam shovel.

It may be advisable to insert here a paragraph describing the manner in which the river was handled during construction. When work was commenced the only outlet from the lake was at the crib dam, shown on the general map (Fig. 2), about 1500 ft. northeast of dam-site. During the first season a channel 20 ft. wide was excavated to the east of the conduit trench cutting off a long bend in the river. At the lower end of this cutoff channel a timber drop was built to take up the difference in grade, about 18 ft., and to allow the river to pass through it without cutting. By the time the drag-line excavator,

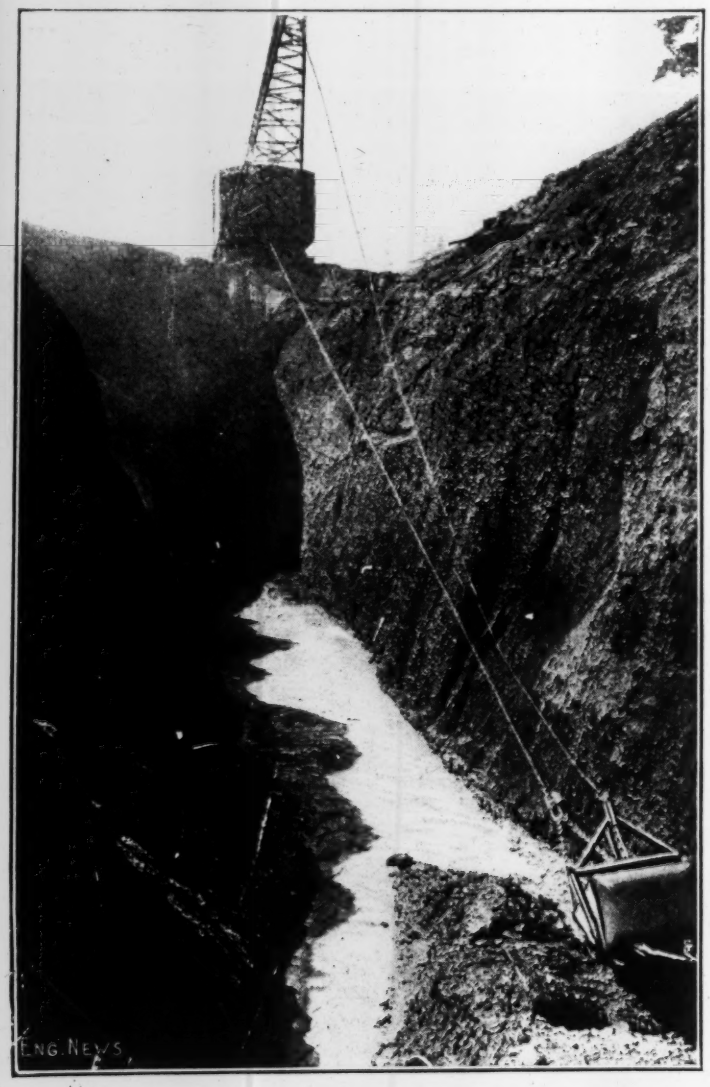


FIG. 3. LIDGERWOOD-CRAWFORD DRAG-LINE EXCAVATOR WORKING IN BOTTOM OF INTAKE- CONDUIT TRENCH, KACHESS DAM

(A cable from a donkey engine is pulling the bucket back.)

operating in the conduit trench, reached the first river crossing this channel was ready for use and at the proper time the excavator dumped its material into the river bed, forming an immense dam at no expense, which diverted the river through the new channel. This carried the river entirely away from the outlet or other works, interfering only with the construction at the east end of the dam, which caused no delay or expense as it was not necessary to work in that portion until the flow could be turned through the conduit.

It was intended to make the excavation for the conduit through the dam and for the open channel below the dam, with teams. The work was started by that method early in the season of 1911 but the material was so hard and stony that it was decided to take it out with a steam shovel, there being one on the project. In order to have no interference from the river, and to carry on the work so as to avoid excessive pumping, a narrow ridge 50 ft. high extending across the outlet trench near Sta. 39-00 was taken out with the teams. The material was generally cemented gravel and the slopes were so steep that teams could not work on them. Early in May a "coyote hole" was dug into the middle of the ridge from the lower side just above water level and 160 kegs of black powder exploded in it. The shot broke the hard crust, flattened the inaccessible slopes and rendered easy the team work that followed.

The steam shovel, a 45-ton Bucyrus, was started about this time and operated between Sta. 26 and 39. The bottom of the channel was to be as narrow as 15 ft. in places and as the maximum cut was 35 ft., with 1½ to 1 slopes, it was necessary to make 5 separate cuts. On the last cut the shovel went down the river 500 ft. below the end of the outlet, running on blocking as it was working in 2 ft. of water, to excavate a channel in river bed and insure a good grade. The material was all loaded into 1½-cu.yd. dump cars, hauled on track by teams and wasted. The final trimming of the conduit and open trenches was done by teams and by hand.

CUTOFF TRENCH FOR DAM.

The wide cutoff trench was excavated with teams and the drag-line excavator. The portion west of dam conduit was done wholly with teams and was pushed to permit the starting of the core-wall trench. The higher portion of the trench, east of the dam conduit, was done by teams. When water was encountered it was left for the excavator. The drag-line excavator deposited the material at the upstream toe of the dam, making an excellent footing for the riprap, also disposing of the material with one handling.

CORE-WALL TRENCH FOR DAM

The excavation of the core-wall trench was commenced early in July, 1911, west of the dam conduit. The upper few feet were shoveled into wheelbarrows and wasted. Shafts were excavated ahead of adjacent portions of the trench, then the excavation was carried in horizontal benches about 7 ft. high. One or two men worked on each bench, loading the material into wheelbarrows, wheeling it along the bench to the side of the shaft and dumping it into a vertical chute that carried the material to a wood bucket of ¾-cu.yd. capacity, heavily ironed and operated from the head frame. When filled, the bucket was hoisted to the head block, where a simple device dumped the muck into a 1½-cu.yd. car, in which it was hauled by one horse to waste dump. A double drum hoist was used which enabled two shafts to be worked by one hoisting engineer. This method allowed a number of men, working at different levels, on platforms laid on trench bracing, to work from each shaft.

It was intended to carry this trench to bed rock but the entire excavation was in such uniformly good material that it was considered unnecessary to go so deep. The maximum depth reached was near the westerly end which was carried to Elev. 2153, or 75 ft. below the original ground surface. The material stood so well that generally the excavation could be carried about 10 ft. without sheeting. This greatly facilitated the work. Sheeting of

2-in.x10-ft. plank was used, with 4x6-in. walings and bracings of round timber. The sheeting could usually be placed without driving.

As the core-wall was to be only 2 ft. thick, and it was difficult to carry the excavation narrower than 4 ft., the downstream side was carried true to line, so that the sheeting on that side could remain, and also to give room to remove the forms from the upstream side.

Concrete Work.

On Dec. 15, 1910, about 200 ft. of conduit trench nearest the lake was practically ready for concrete. As the conduit must be in place before the temporary dam could be built over it and the temporary tower and gates installed, all of which were necessary to control the water for the next season's work, and since the trench was about 50 ft. deep and would probably fill with water, causing the sides to sluff in, it was decided to construct the conduit regardless of season and weather conditions. The aggregate had previously been hauled and forms, built in sections, were on the ground.

A convenient plant was erected at the top edge of the trench, which enabled all materials to be handled by gravity. A trestle was erected sufficiently high to clear the structure and on it was placed a track for carrying the concrete cars. The weather was quite favorable for that time of year but the temperature was below freezing practically all the time and there were frequent snowfalls of one foot or more. All materials were heated, the work was practically enclosed, fires were kept going continually, and steam generously applied to old concrete before placing the new. There was considerable form work and the structure was heavily reinforced, which somewhat hindered the work. Caving banks frequently damaged the forms and caused delay. The work was generally carried in three shifts, with small crews, and was not only successfully completed but the concrete is perhaps better than the average.

During the following season, 1911, the conduits were completed under more favorable conditions. Early in May a mixing plant was erected on the downstream slope of the temporary dam, arranged so that all materials and concrete could be handled by gravity. As before, a trestle was erected over the proposed structure, carrying a 2-ft. gage track on which the side dump concrete cars operated. This plant was fairly economical but being at the end of the trench the haul soon became an important item and the limited room around the mixer considerably restricted the output. As the drag-line excavator completed a section of trench it would be trimmed by hand and the material dumped ahead where the excavator could reach it. The concreting followed closely. Within one week of the time the excavator completed the excavation of the trench, 1400 ft. long, the conduit was finished.

When the excavation of the trench had sufficiently advanced, the mixing plant was moved to Sta. 20-25. As this plant proved very economical of operation and contained some novel features a description of it may be of interest (Fig. 4). A Ransome mixer of 1 cu.yd. capacity was set up at the west side of the trench, sufficiently high to dump into steel side dump cars of equal capacity, placed on a trestle over the conduit. At the top of the natural bank above the mixer, a storage bin, with three compartments (total capacity 80 cu.yd.) was built. It was connected to the mixer with a chute in which measuring devices and a batch hopper were introduced. Three gates at the entrance to the chute, leading from the different compartments in the storage bin, allowed the different grades of aggregate to pass into measuring boxes; then, by opening one gate below, the measured aggregate passed into the batch hopper ready to go into the mixer.

The obtaining of aggregate had been a difficult problem from the time work started. There was no suitable gravel within a mile of the work and the pits located at even that distance were heavily timbered and covered with a layer of from 4 to 6 ft. of soil and clayey material; furthermore, this gravel was in private ownership. In sluicing the cemented gravel thrown out by the excavator, from the edge of the trench excavation, it was noticed that the material remaining after sluicing seemed satisfactorily graded for concrete work. Mechanical analysis of the washed material demonstrated the feasibility

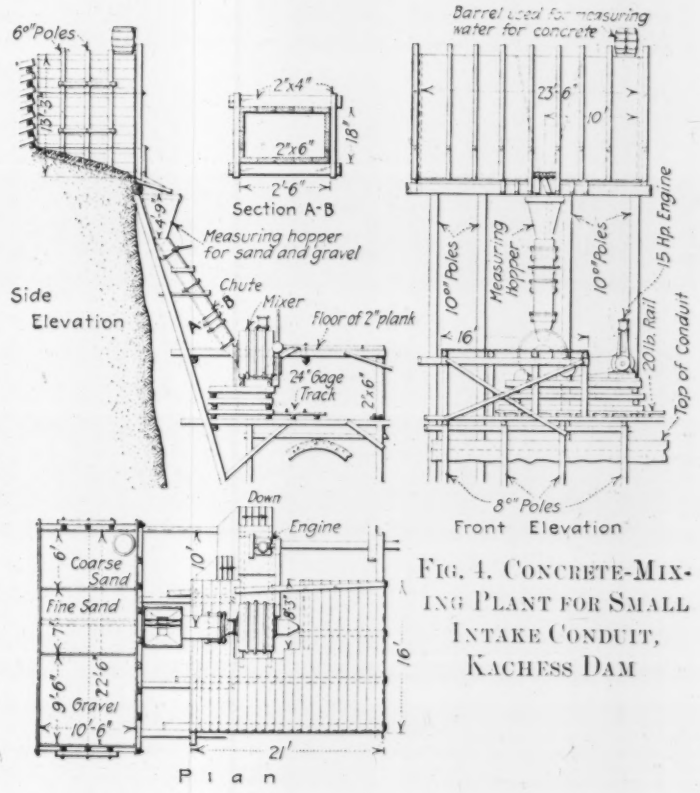


Fig. 4. Concrete-Mixing Plant for Small Intake Conduit, Kachess Dam

of using it providing a satisfactory washing and screening plant could be devised.

Suitable bins were built, a revolving screen with elevator erected and the scheme given a trial which proved successful. The unwashed material was hauled with teams and drag-scrapers to a platform having an open hopper through which it passed to the elevator which carried it to the revolving screen. A small stream of water delivered inside the screen, and playing continually on its entire length, washed the gravel, removing practically all the dirt. At first there was some difficulty in retaining the finer sand but by using extra screens of very fine mesh, suspended beneath the revolving screen, and by introducing additional troughs and pipes to carry off the silt, very little of the fine sand was lost, though it was necessary to obtain a small quantity elsewhere, which was the purpose of the third compartment in the storage bins.

The storage bin was located with reference to this screening and washing plant, the grade being such that

one horse could haul the prepared aggregate to the storage bin in 1½-cu.yd. dump cars, running on a track. When working to its best advantage the force employed was two teams hauling to the elevator, two men at the screen and two men and one horse hauling from the screen to the storage bin. The cost of aggregate delivered in the storage bin was 85c. per cu.d. of concrete. The cement was received from the opposite bank. To turn out 100 cu. yd. of concrete in 8 hours required, in addition to the above, one man gaging aggregate, one man handling cement and one man running the mixer and engine.

Owing to the cramped and wet quarters in which this conduit was built (in a trench from 30 to 55 ft. deep and 15 ft. wide and often confined to a stretch 150 ft. long, the sides slufling in, knocking out forms and so much water that two pumps were running much of the time), the work had to be crowded day and night in order to allow water to pass through it by Sept. 1, on which date it would be needed for irrigating purposes. At one time there were eleven distinct gangs in a 24-hour day, each having its independent duties, working in tween the core-wall and the side of the trench was carefully filled and puddled.

The portion of the core-wall east of the dam conduit was put in from a plant located at the east abutment of the dam. This plant consisted of a ½-cu.yd. Smith mixer and a gravity arrangement for handling materials with a storage hopper of about 80 cu.yd. capacity for aggregate. Gravel from a pit opened for embankment construction was excavated by the drag-line excavator, loaded onto cars and hauled by teams to the hopper. An interesting feature in connection with this plant was the behavior of the chute leading from the hopper to the mixer. This chute was of planed lumber, 10 in. deep, 24 in. wide and about 30 ft. long, with gates near the bottom that controlled the flow and measured the aggregate. The chute was built on a slope of 1.6 to 1 but it was found that the gravel would not run. The bottom and a few inches on the sides were then lined with thin sheet iron, which caused the gravel to run, keeping the chute just even full without slopping over, although it was open on top.

From this plant a trestle was erected over the proposed

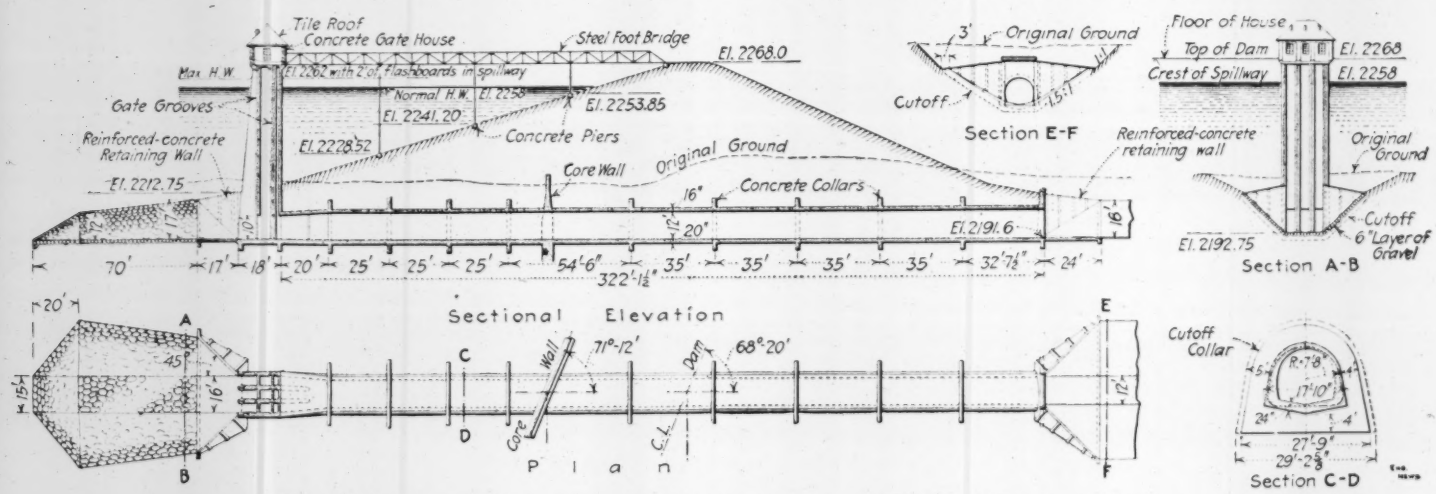


FIG. 5. GENERAL PLAN AND SECTIONS OF OUTLET WORKS, KACHESS DAM

a stretch 200 ft. long. These gangs were divided into shifts, excavating and trimming, placing and removing forms, placing steel and placing concrete. The conduit was sufficiently completed on Aug. 23, when the work was suspnded, to permit of water passing through it on Sept. 1.

It was planned to construct the dam conduit from the plant described above but on account of the necessity of drawing substorage water during September it could not be built until the close of the irrigation season. As there was considerable concreting ready in the core-wall trench it was decided to move the mixing plant to Sta. 28-50 on the east bank of conduit trench where it would be handy to the dam conduit, tower, etc., also suitably located for building the westerly portion of core-wall. The plant erected was not quite as economical as the preceding one but everything was handled by gravity and was quite satisfactory. The aggregate was hauled from the combined washing and screening plant. The dam conduit trench was bridged and a track laid across it to the core-wall trench. The bottom 4 ft. of the trench was concreted without forms, making a foundation about 4 ft. wide; above this forms were used on the upstream side and later removed. The sheeting of the trench on the upstream side was also removed and the space be-wall sufficiently high to just clear the finished work. A track was laid and end dump cars of ¾-cu.yd. capacity built. Beneath the track short vertical chutes with wide tapering openings were suspended about 50 ft. apart. Below these, light portable chutes were used to deflect the concrete, as dumped from the cars, into all parts of the forms. The concrete was worked over in the trench to insure thorough mixing and as many plums were incorporated as the concrete would stand. The core-wall was carried up the end abutments of the dam in steps to within 5 ft. of probable high water.

At the close of the irrigation season the temporary gates were closed and the dam conduit constructed. No difficulties were encountered. The ribs for the forms had all been prepared, the transition forms were built in sections ready for use, reinforcing steel had all been cut and bent to proper shape while water was being delivered. As in other concrete construction on this work a trestle was built over the conduit and concrete delivered to all parts by gravity. The invert was first built, except a gap of about 20 ft. at the junction with the core-wall. Then the side walls and lastly the arch were constructed. The arch was carried up about 3 ft. on each side, the day's work finished to a radial plane, then the balance di-

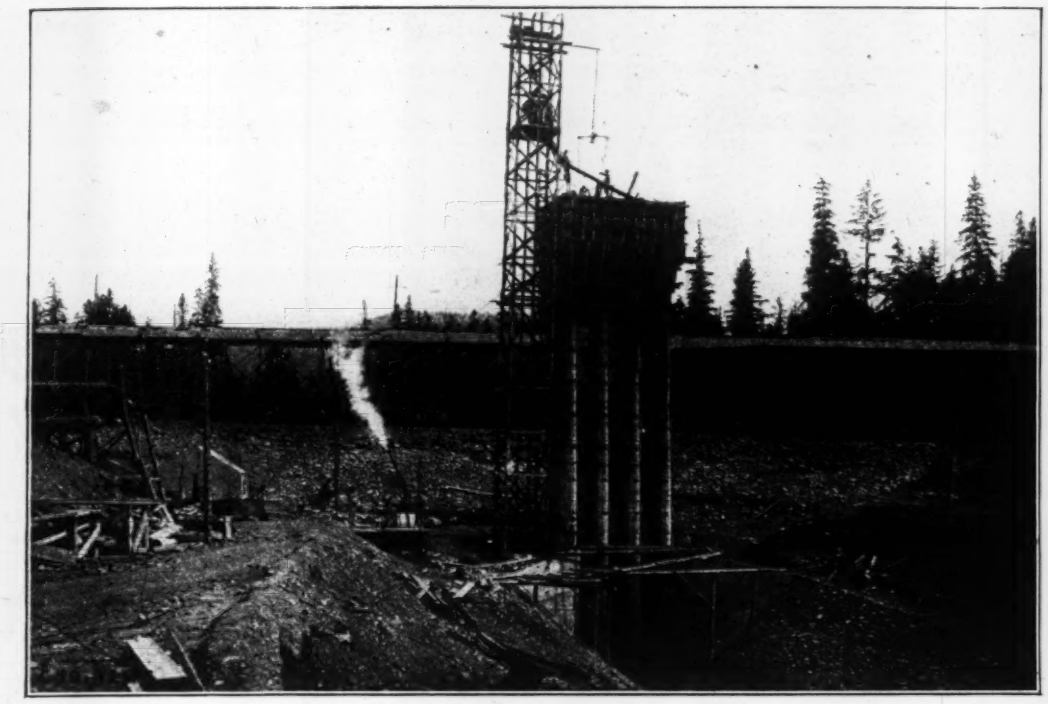


FIG. 6. GATE TOWER OF KACHESS DAM NEARING COMPLETION

(The view also shows the concrete mixer at the ground level on the left, the hoisting tower and the concrete chute leading from the concrete car. Beyond the tower is the dumping trestle used in building up the dam.)

vided into sections equivalent to a day's work and each section completed in a continuous run. The slope walls of the intake and the foundation for the gate tower were constructed at the same time as the conduit. As shown in Fig. 5 numerous cutoffs in the form of collars are provided to prevent seepage along the branch of the conduit. Those upstream from the core-wall are 15 in. thick, extend 4 ft. outside the conduit and are spaced 25 ft. apart, while those below the core-wall are 15 in. thick, extend 4 ft. beyond the conduit and are spaced 35 ft. apart. The core-wall itself acts as a very effective cutoff, as the section immediately around the conduit was built at same time as the conduit and connected with it by reinforcing steel. This conduit is 322 ft. long and contains 1390 cu.yd. of concrete.

The construction of the gate tower was commenced on May 30, 1912, from the plant near Sta. 28-50. All the concrete used in the construction of this feature and in the gate house was handled in side dump cars, which were run onto an elevator operating in an 8x8-ft. wooden tower 110 ft. high, built just east of the gate-tower (Fig. 6). The car was stopped at the elevation desired, the concrete dumped into light movable chutes which conducted it directly into the forms or into boxes from which the concrete was shoveled into place. The form work and placing of reinforcing steel was done by an extra crew, usually working as a second shift, which enabled the concrete crew to work without interruption.

In plan the gate-tower is in 3 sets of 3 compartments each (Fig. 7). The upstream compartments contain the emergency gates, the downstream compartments contain stop plank grooves, while the interior compartments contain the regulating gates. The operating mechanism, installed on the floor of the gate house, is so arranged that the gates can be operated either by hand or by power. Power is obtained from a small turbine installed in the west stop plank compartment. To prevent drift from reaching the gates an ample grillage of structural steel is provided. It has an effective area of 1200 sq.ft., or 10 times the area of the gates, and extends from the floor of the intake to 1 ft. above spillway level. The gatehouse is 15x23 ft., of concrete, in pilaster and curtain-wall construction, with tile roof. Access to the gatehouse from the dam is by means of a steel foot bridge 161 ft. long supported on three steel bents.

THE SPILLWAY

There being no occasion to crowd the spillway (Fig. 8) work, and as it presented no construction difficulties and required no fixed plant, it was used as a knitting job and worked on intermittently as men and teams were available from other features. Clearing and grubbing, which was comparatively light, was commenced the latter part of May, 1911. Excavating amounting to 33,500 cu.yd., of which 7000 was Class 2 and 3, was done wholly with teams. Paving of the bottom was commenced in September, 1911, and completed in September, 1912. The paving was from 12 to 18 in. thick, laid almost entirely from rock obtained from the excavation. It consisted of both dry and mortar paving, there being 1250 cu.yd. of the former and 250 cu.yd. of the latter.

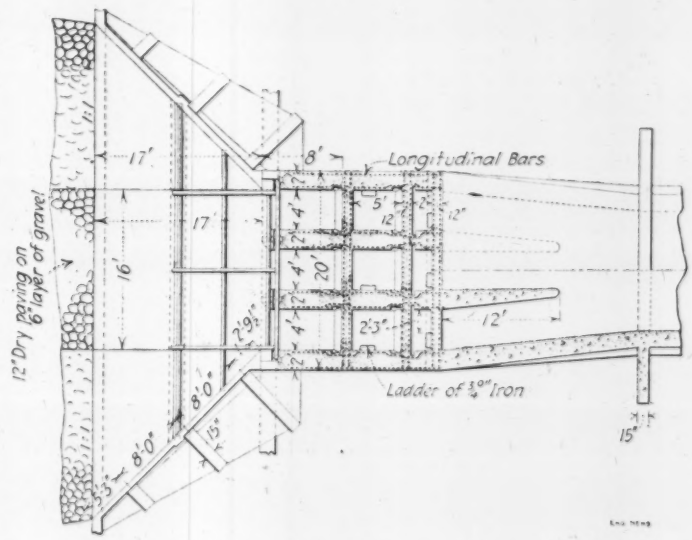


FIG. 7. PLAN OF GATE TOWER, KACHESS DAM

The concreting was all done in the season of 1912. The mixing plant was very efficient and unusually cheap for a small piece of work, possible on account of the topographic conditions. Advantage was taken of the high ground at the west end of the spillway and sloping toward it; a log bulkhead was built to retain the gravel aggregate, which was hauled by dump wagons. In the lower portion of the middle of this bulkhead a chute was placed, through which the aggregate passed to a rectangular steel car on a short track. This car was used as a measuring

device as well as to transport the aggregate to the 1-cu.yd. Ransome mixer, which was only a few feet in front of it. From the mixer, the concrete was dumped into steel side-dump cars, running on a track over a trestle, parallel with the weir, and sufficiently high to deliver the concrete through chutes to practically all parts of the work. From this plant 1400 cu.yd. of concrete were placed, the cost of the plant being 11c. per cu.yd. of concrete. The weir was constructed in alternate sections, 25 ft. long, and the floor in alternate sections, 12½ ft. square.

Placing and Riprapping the Embankment.

The preliminary investigations for borrow pits indicated that there were two locations from which tight material could be obtained. One of these was located within 1000 ft. of the east end of the dam while the other was about 1500 ft. from the west end. The subgrade of the easterly pit would be at the same elevation as the crest of the dam, while that of the westerly pit would be 20 ft. below it. There was no choice in the location of a pit for loose material as the only available material of this kind, suitable for the work, was found at a distance of some 2500 ft. from the east end of the dam.

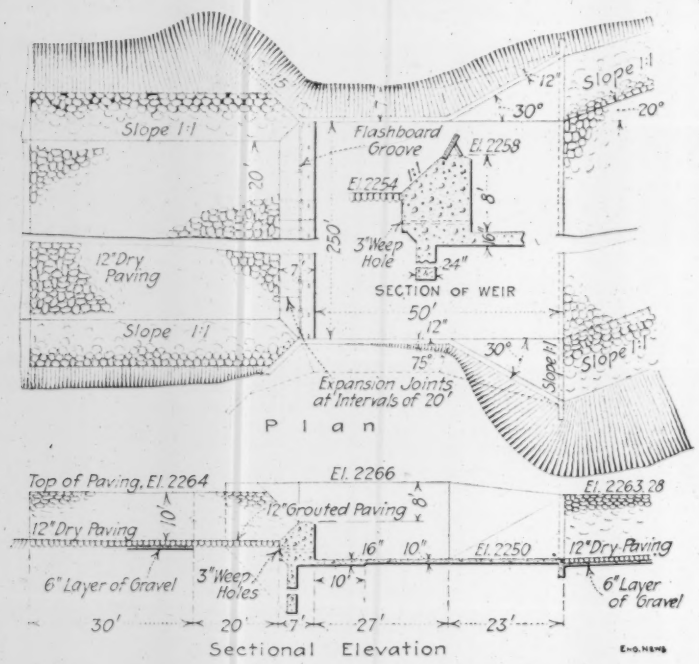


Fig. 8. Plan and Sectional Elevation of Spillway of Kachess Dam

In order to decide between the pits for tight material, to determine their fitness for the work and to be sure that no better material was available, also to determine the method of placing it in the embankment, a careful and extensive investigation was made during the season of 1911. Fig. 2 shows the number and location of the test pits finally selected but does not indicate the borings and pits put down prior to the commencement of construction operations, to determine the feasibility of the dam site and its exact location; of these there were about 30 test pits, from 10 to 35 ft. deep and 25 drill holes, from 26 to 92 ft. deep.

A classification of the material was made and mechanical analyses made of samples taken from different depths. In all about 50 samples were tested. A complete set of screens from No. ¾ to 200 were used. These tests indicated that the material in the east borrow pit was fully as good for the work intended as that in the westerly pit and better than from any other available location; moreover, it was much more accessible to the dam, a level or downhill haul and adjacent to the borrow pit for loose material, which was a great advantage on account of ability to concentrate water-supply, fuel, track and repair work, within a much smaller area than if the pits were more widely separated; for these reasons the easterly pit was selected.

The material in this borrow pit proved even better than the tests indicated. The upper 3 ft. consisted of top soil light in weight and containing a large amount of fine earthy material and, with the exception of scattered boulders of large size, this layer contained about 50% of the boulders found in the pit. Below this, hardpan was found consisting of clay, sand and approximately 35 to 40% of gravel, both coarse and fine. This layer was so hard as to require shooting, but below it, while the material contained about the same ingredients, with possibly a larger percentage of clay, it was not so firmly cemented. The screening tests of Pit *T* (Fig. 2) made from a mixture of samples from different depths, may be considered fairly typical of the material used for the tight portion of embankment and ran as follows:

Screen No.	¾	½	1	1½	2	3
Per cent. passing	98.3	94.7	91.6	83.6	74.9	68.9
Screen No.	4	10	20	40		60
Per cent. passing	60.3	47.3	38.3	31.3		26.1
Screen No.	80	100	165	200		
Per cent. passing	23.3	21.3	18.0	16.7		

Careful consideration was given to a determination of the method by which this dam should be constructed; whether by the customary rolling method or by hydraulicking the material into place from the slopes of the embankment, which was the method used in constructing the Bumping Lake dam, about 60 miles northwest of North Yakima, Wash. The rolling method was finally decided upon. Early in March, 1912, the construction of a timber trestle from which to dump the material was commenced. The trestle was 800 ft. long, of which 300 ft. averaged 60 ft. high. It was built of round timber, saved from the clearing; except the caps and stringers, which were of sawed timber, to save time in erection. The bents were 20 ft. apart, three posts to a bent. The trestle was located practically on the center line of the dam, with the base of rail at the proposed crest. It was double tracked with 30-lb. steel rails, 24-in. gage. A double track was laid to the borrow pit for tight material and a single track, with sufficient turnouts, to the borrowpit for loose material. From the west end of trestle a single track was extended about 300 ft. on a road-bed made with teams and beyond this point the material was hauled by teams.

While the trestle was being constructed, the borrow pits prepared and track laid, the cutoff and conduit trenches were backfilled. The hand work of filling in cramped quarters had been done the previous season. The steam shovel was moved to a 25-ft. bank of fine material just east of the outlet of the small conduit. Temporary tracks were laid and the filling was done by loading 1½-cu.yd. cars with steam shovels and hauling them by teams. The trenches contained some water. The material was dumped, then worked into the water and pud-

dled. When the fill got sufficiently dry to permit of using teams, the spreading was done with slips and fresnos.

About May 1 the trestle was ready for use, the shovel was moved to the borrow pit east of the dam and the construction of the embankment proper commenced. The pit had previously been cleared and some blasting done. The material from this pit was loaded into trains of 15 1½-cu.yd. side-dump cars, hauled by 9-ton steam locomotives. It was dumped from the upstream side of the

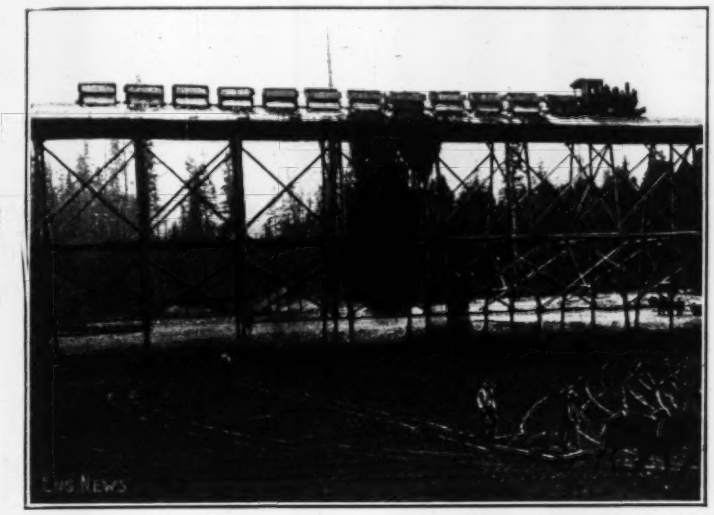


FIG. 9. DUMPING EARTH FROM TRESTLE, KACHESS DAM

trestle, falling to the ground below. At first the material fell inside the outer posts, but the addition of a deflecting apron 7 ft. long, covered with sheet iron, caused it to fall just outside the posts (see Fig. 9). Spreading was done with fresnos of four-horse size, but usually drawn by three large horses or mules. It was found after the work became systematized that one fresno would distribute about 115 cu.yd. of the tight material in eight hours. The gravel or loose material was loaded by the drag-line excavator into a specially constructed hopper, of 40-cu.yd. capacity, mounted on skids for moving and fitted with two chutes and controlling gates, which enabled two cars to be loaded at a time. It was hauled in trains of twelve cars, dumped from the downstream side of the trestle and spread with four-horse fresnos. One fresno would spread from 150 to 175 cu.yd. of gravel in eight hours, the haul being much shorter than for the tight material and the gravel more easily loaded.

On account of the small working space of the embankment, difficulty was at first experienced in spreading the material as fast as it came in, but while the capacity of the machines was never taxed, a system was soon devised whereby it was kept pretty well cleaned up. About ten trains would be dumped in one pile, then another pile of ten train loads would be made, near the first pile, leaving only room for a roadway between, then a third pile adjacent to the second. While the second pile was being made, the first pile would be spread and stones picked from the second pile; then while cars were dumping on the third pile, the stones would be picked from it and the second pile spread. In this way there was no waiting and no confusion, the roller working on the area previously spread. The tight material occupied the upstream two-thirds of the dam (Fig. 10) and the gravel in the downstream third; it was handled in the same way except that it spread much easier, and the piles did not require plowing, which was necessary with the tight material, the impact from falling, particularly in the lower levels of the embankment, compacting this material very tightly.

The tight material was spread in 8-in. layers and all stones exceeding 4 in. picked out, loaded into one-horse dump carts, and placed on the upstream slope (Fig. 11). A road grader was on the work but the fresnos spread the material so evenly it was not used. The layer was then sprinkled by a 2-in. hose with ¾-in. nozzle, the amount of water varying greatly and depending on the weather and the material. The tendency at first was to use too much water, which produced a kneading motion in front of the roller. Carefully watching conditions and reducing the amount of water, sprinkling often with a rather fine spray, corrected this condition. The rolling was done with an ordinary 16½-ton traction engine. Extension rims on the driving wheels gave a rear wheel base of 56 in. Assuming that they carried two-thirds of the weight, the pressure per lin.in. was about 400 lb. This engine seemed about the right weight for the materials and an excellent embankment was obtained.

It was found that the compacted layer was slightly less than 6 in. in thickness. Test pits were put down frequently and at predetermined points, in order to have a complete record of the behavior of the material, to determine whether or not the proper amount of water was being used, and, in general, to indicate whether there was anything to be guarded against or improved. No stratification was apparent; the only adverse criticism to be made was that certain layers that had been exposed to rain showed a little too much water.

The gravel was spread in a similar manner except that small stones were not so carefully picked out. The rolling was done by a grooved roller drawn by four horses and more water was used than on the upper side. The stones picked out were placed on the downstream slope. The junction of loose and tight material was approximately at the downstream posts of trestle bents. To place the large amount of material in the short season available, the small area of the dump preventing the crowding of the machines, the shovel and embankment work was carried in two 8-hr. shifts, but as only half as much material was required from the excavator it only operated one shift. The best run of the shovel was 1105 cu.yd. and of the excavator 1000 cu.yd. in eight hours.

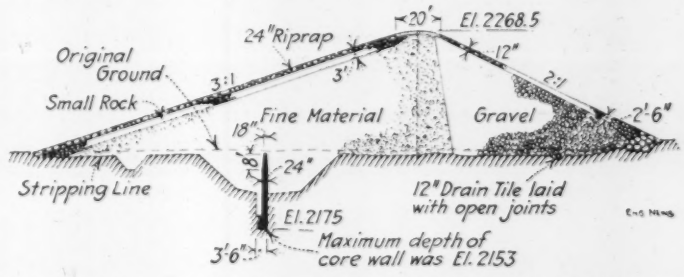


FIG. 10. TYPICAL SECTION OF KACHESS DAM, YAKIMA IRRIGATION PROJECT, WASHINGTON

The embankment was practically all placed in four months. All trestle bracing was taken out as the fill advanced, nothing being left in but the posts. When within 8 ft. of the top, the gravel portion was brought up about 6 ft., one track thrown on it, the balance of the trestle removed and the remainder of embankment completed.

DRAINAGE—A very complete drainage system was pro-

vided to lead off harmlessly any water that may find its way into the dam. At the downstream toe is a generous trench from 6 to 10 ft. wide in the bottom, from 6 to 8 ft. deep, extending the entire length of the dam, backfilled with stone, which filling is also carried some distance up the slope. From 30 to 60 ft. upstream from the toe is a 12-in. tile drain, laid with open joints in a trench and surrounded with 2 ft. of small stone; this drain has frequent outlets to the main drain at the toe. Should water succeed in passing through the tight material it will drop in the gravel portion, which contains practically no clay, and escape through the drains.

RIPRAP—The upstream slope is protected from wave action by a 2-ft. layer of riprap placed on a bed of small stones 3 ft. thick, thus making a thickness of 5 ft. of rock between the embankment material and the waves. The smaller stones are generally against the embankment while the outer stones are practically all at least 2 ft. thick, many of them being of derrick size. The downstream slope requires no protection, but to prevent raveling and to better hold the material, it is faced with a layer of small stones picked out of the loose material. This layer is thicker at the bottom than at the top and will average 3 ft.

FIG. 11. UPSTREAM RIPRAPPED SLOPE OF KACHESS DAM, YAKIMA IRRIGATION PROJECT, WASHINGTON
(The outlet tower or gatehouse shows on the extreme right; also the concrete hoisting tower used in constructing the gate tower.)

WORK ACCOMPLISHED

The principal work accomplished was as follows:

Clearing	50	acres
Grubbing	16	"
Excavation	550,000	cu.yd.
Concrete	8,635	"
Dry paving, 12-in.	1,600	"
Grouted paving, 12- and 18-in.	1,250	"
Gravel under dry paving	625	"
Backfill	32,000	"
Rockfill	2,700	"
Riprap	8,500	"
Embankment	182,000	"
Drain pipe, 12-in.	900	lin.ft.
Drain pipe, 8-in.	100	"
Reinforcing steel	300,000	lb

CONSTRUCTION PLANT AND CAMP

The plant used was fully adequate. Much of it had seen service at Bumping Lake Dam and was well suited to the work. In addition to the machines already mentioned, there was sufficient rolling stock to handle the combined output of the excavating machines, a large supply of equipment for team work, hoisting engines, derricks, stationary engines, pumps, boilers, small electric light plant and the small equipment usually associated with a large excavating and masonry contract. The machine shop was unusually well fitted up for handling large work. In addition to the customary equipment there were a steam hammer, drill press, cutoff and band saw, lathe, etc., all operated by power. There was very little repair work that could not be done in the shop and its excellent facilities saved many delays and their incident cost.

A very comfortable camp, with ample accommodations for 400 men, was erected. It was regularly laid out on a topographic map of the site before commencing its construction; the different buildings and quarters were arranged with respect to their relation to each other. Such buildings as the office, warehouse, mercantile store, mess and repair shop were located where they would be the most central to those using them and to the work. The quarters for foreman, clerks, mechanics, etc., were regularly spaced and at a uniform distance from the road. The laborers' quarters were similarly spaced but on a different thoroughfare.

One of the most popular features of the camp was the club house, a building 24x48 ft., conducted for the benefit, amusement and welfare of the men. It was in charge of a Y. M. C. A. Secretary who gave his entire time to the work. The building contained a variety of games, was well supplied with reading matter and writing material. The men were encouraged to use its literary features and there were classes for those who wished to improve their education. It very successfully served its purpose of entertaining the men and keeping them from a neighboring town which was not a "dry" town.

A well equipped hospital with a resident physician in charge, who also had oversight of the sanitary condition of the camp, was in operation during the season of 1911 and 1912. Convenient to the different portions of the camp were toilets and bath-houses, the latter containing a sufficient number of bath tubs and shower baths.

Running water was placed in all the principal buildings, while numerous hydrants, scattered through the camp, made it accessible to all. The water-supply was

excellent but somewhat expensive, as it was all pumped from deep water in the lake to a tank on the hill above the camp.

There were six corral tents with accommodations for 168 head of stock. The largest number of animals, mostly mules, working at one time was about 150. The largest force employed was 410 men.

The Kachess dam was built under the direction of Chas. H. Swigart, supervising engineer, United States Reclamation Service, with the writer in direct charge. R. E. Post, assistant engineer, was superintendent of construction and John R. Sherman, assistant engineer, in charge of engineering.

❖

An Opportunity and a Purpose for a Local Organization of a National Engineering Society*

By Chas. B. Wing†

In 1887, William E. Worthen, in the presidential address of that year before the American Society of Civil Engineers, said: "The Engineer must know not only what to learn, but how to learn and reciprocate for the information and pleasure of others."

Would it not be well for us who are intimately connected with the engineering work of this portion of the world to study carefully the work that has been done here in the past; and thus learn to appreciate the achievements of the pioneers in Pacific Coast engineering?

Geo. H. Benzenberg, in his presidential address in 1906, truly said, "The respect and esteem which a community entertains toward any profession or its members is always in proportion to that which the members of such profession entertain toward one another."

The community as a whole is more or less familiar with the material results of the engineering work of this section, but how many even among ourselves know much of the names and much less of the personalities of the engineers to whose devotion and labor these achievements are due, or of the difficulties which they encountered in doing their work?

Would not the esteem of the profession in the community be enhanced if we should honor these men, not only among ourselves, but also in public?

The building of the Central Pacific R.R. during and immediately following the Civil War was one of the greatest feats of engineering this country has seen. It is true that many of the problems connected with grades, curvature, track and motive power had already been settled by the experience of the previous 25 years of railroad building in the East.

The work accomplished, however, is comparable to that of building the Panama Canal—the overcoming of material obstacles and not the solving of new scientific problems. One point of difference, however, existed. The Panama Canal has had the whole wealth and financial strength of the United States back of it. The builders of the Central and Union Pacific railroads had only a gift of supposedly valueless lands and a chance to use "I. O. U.'s" with which to build thousands of miles of railroad across the great American Desert, and over a mountain range 7000 ft. high, whose eternal snows had held back and destroyed the Donner party.

Looking back today, it is hard to realize the magnitude at that time of the difficulties confronting this enterprise. And yet to one man in large measure belongs the credit for carrying this work through to completion—the engineer whose broad-minded, far-seeing judgment and capacity enabled him to convince his principals and the leaders of the government of the wisdom and ultimate worth of undertaking this apparently impossible task.

All of us today are familiar with the names of those who reaped the financial rewards accruing from the ultimate success of the enterprise, but how many of the younger generation know the name of Benjamin P. Judah, the engineer to whom the success of this great work is largely due, and who practically gave his life to its achievement?

Surely it is our duty to the profession to see that the history of this enterprise is known to the younger generation and that to them the name of its engineer becomes as familiar as the names of those who lived to receive the financial rewards.

This in brief is the story of but one Pacific Coast enterprise. We might well ask who developed the first hydraulic mines, who built the Tehachipi loop, the first hydraulic-fill earth dams, arched dams, cable railways, hydro-electric installations, impulse waterwheels, centrifugal pumps, and so on through a list of engineering developments which if not originated by Pacific Coast engineers, have all received their greatest development here.

A series of properly illustrated papers on such topics as those outlined would not only prove entertaining to us for our evening meetings, but would also entertain audiences made up of others than engineers, and afford an excellent opportunity for some of our members to honor themselves by honoring those members of our profession to whom credit is due for conceiving and carrying through to commercial success these great works.

Geo. S. Morrison, in his presidential address in 1895, said, "The engineer must measure himself with others and must stand to be measured . . . . . The profession can only do its future work by trained minds working together."

Perhaps in learning to appreciate more fully the work of those who have preceded us, we shall be led to value more the work of our contemporaries, and by working together achieve still greater success than has been obtained in the past.

How can this Association of ours best serve our needs and help us in our preparation for the work to be done? In 1902, Robert Moore, in his annual address said: "Engineering should be one of the learned professions . . . . . The special function of the Society is to aid in the higher education of the engineer."

I fear some of our younger members are inclined to place undue emphasis secretly, if not openly, upon the fact that they have been educated at such and such a place, or that they have worked under so and so. Perhaps some of our older members are inclined to expect too much from the preliminary training that is now quite generally accepted as necessary for those hoping to become engineers.

To a certain extent, engineers are born, not made. The head of a college of engineering in one of our leading universities has said: "We cannot be expected to turn out engineers . . . . . We can merely help to train men with great capacity for becoming engineers."

It would seem that one function of an Association such as ours should be to encourage and help those young men with "great capacity for becoming engineers"—to help them to help themselves. Perhaps no better way can be suggested to help them than by giving them an opportunity to "measure themselves with others and stand to be measured."

❖

The Chingford Storage Reservoir, recently completed by the Metropolitan Water Board, London, England, has a storage capacity of 3,600,000,000 U. S. gal. and is wholly in excavation and embankment. The reservoir has an area of 416 acres and is about a third of a mile wide and two miles long. The total length of the embankment is about 4½ miles, involving 2,060,000 of material, all excavated from within the reservoir. A novel feature of the contract was that the contractor (Messrs. Charles Wall, of London) was given a free hand as to excavation and embankment, provided only he supplied the designated capacity and left the bottom so it sloped toward the outlet from every point. The bank is some 28 ft. high, 15 ft. wide on top, with an outer slope of 2½ to 1 and an inner slope of 3 to 1 on the upper and lined portion and 4 to 1 below that. A clay puddle wall extends from above the water level to and 3 ft. into the London clay. This wall is 5 ft. wide on top, and tapers uniformly for a depth of 23½ ft., where the width is 9 ft. From this point to within 2½ ft. of the original ground surface the width of 9 ft. is maintained; the rest of the way the wall is 6 ft. thick. The 15-ft. width of the top of the bank includes a vertical parapet wall of concrete and brindled brick, the concrete going down 4 ft. At a little over 2 ft. from the top the brickwork curves to a junction with the slope and continues to rest on concrete for a slope distance of 19½ ft., beyond which a thinner layer of concrete (in slabs here) extends for 20 ft. To lessen wave action it is divided about halfway in its length by an embankment. The reservoir is filled from the River Lea by means of the Humphrey direct-acting explosion pumps described in issue of Apr. 17, 1913. An illustrated description of the reservoir is given in London "Engineering," Mar. 14, 1913.

---

*From the presidential adress to the San Francisco Association of Members of the American Society of Civil Engineers.

†Professor of Structural Engineering, Leland Stanford, Jr., University, Calif.

Mechanical Oil Burners*

By E. H. Peabody†

SYNOPSIS—In most oil burners hitherto used the oil is sprayed by steam or compressed air to obtain perfect combustion. To burn oil under marine boilers such a system is objectionable, as the amount of steam required to spray and atomize the oil may be 2% to 4% of that generated by the boilers and such a waste of fresh feed-water could not be afforded. To establish an air-compressing plant large enough to spray the oil would also be an objectionable complication and the demand arises, therefore, for a burner which will spray the oil by mechanical means. Mr. Peabody's paper describes the latest make of these burners and the principles on which they are designed.

The "mechanical atomizer," so called, is understood to mean a device which sprays or atomizes oil or other liquids by means of pressure alone, without the use of compressed air or steam or other exterior atomizing agent. Owing to its simplicity and to the fact that no fresh water is wasted, it is being extensively used in the merchant marine, and it has possibilities which may ultimately bring about its adoption on shore. That this change has been and will be slow is not to be wondered at, awaiting, as it must, the growth of the oil-producing industry, but with the increased supply of oil its use as a fuel has spread,

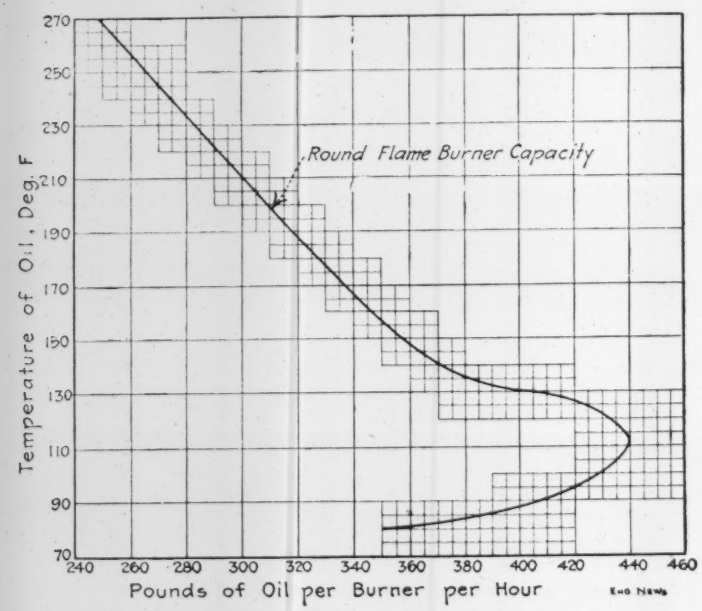


Fig. 1. Curve Showing Variation of Capacity of an Oil Burner with Change of Temperature of the Oil Handled

and with the increased use of oil has arisen the need of better methods of handling. Following the necessity, the better methods have been developed, first in naval practice, and now in wider fields.

Commodore Isherwood's conclusions of some forty years ago hold good today, namely, that atomization of the oil, as distinguished from vaporization or gasification in the burner, is the only method that has been attended with success. There are not wanting those who still claim advantage for those forms of apparatus which, by various methods of treatment of the oil, admit the fuel to the furnace in the form of vapor. These systems, while successful in metallurgical work, have no standing in boiler practice for the reason that they show no gain in efficiency, but, on the contrary, result in very poor capacity, the latter feature alone making them undesirable for marine use.

The well known Koerting process patent, taken out in this country in 1905, contains a claim which covers heating the liquid oil unmixed with air or other gases to a point above its normal boiling-point, maintaining the oil in a liquid state by pressure and delivering the superheated oil into a combustion chamber supplied with air, whereby the rapid disintegration and vaporization of oil in the presence of air are secured. The idea here, as is more fully pointed out in the patent specifications, is that the heat stored in the oil at high pressure will cause the liquid to flash into vapor when released at low pressure, exactly as water, heated above 212° F. under pressure, would flash into steam if released to the atmosphere. This is an exceedingly ingenious way of converting at least part of the oil into vapor without atomizing it, but as a matter of fact no gain results from this partial gasifying of the oil. This question has been tested out experimentally and what is more to the point, nobody is doing it, not even the users of the Koerting apparatus itself. The dangerous expedient, therefore, of heating oil above its flash-point at atmospheric pressure is not found necessary.

The real value of heating the oil is rather a mechanical one,

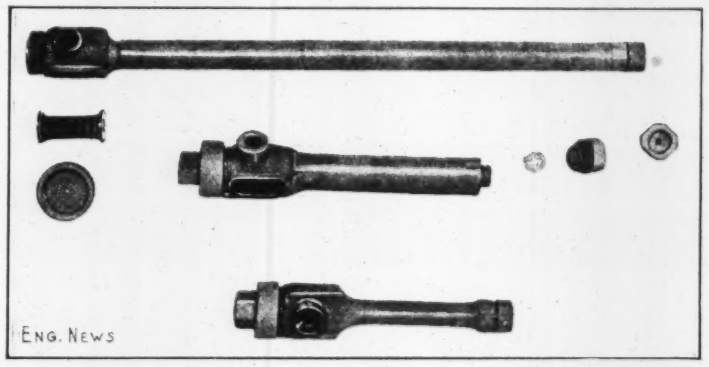


Fig. 2. Parts of the Peabody Mechanical Atomizer for Burning Oil Fuel

namely, to reduce the viscosity of the liquid so that it can be forced through the small passages of the burner and given a rapid whirling effect, sufficient in the more limpid condition of the oil to reduce it to a fine spray through the action of centrifugal force when liberated from the tip. It will be found from a study of fuel oils that, while the viscosity is tremendously affected by changes in temperature at the lower ranges, very little difference in viscosity results from heating or cooling as the temperatures approach the flash-point.

With all ordinary oils it may be considered that heating to within 50° F. of the flash-point will be sufficient to render the oil suitable for use with the mechanical burner, and in the case of many of the lighter oils even this heating is unnecessary, the oil being sufficiently limpid at ordinary atmospheric temperatures.

Several methods of spraying oil by mechanical means have been suggested, such as forcing the liquid through a very fine aperture, forcing a jet of oil at high velocity against some object or against another oil jet, throwing the oil off from a rapidly revolving table or disc, or giving the liquid itself a whirling motion and reducing it to spray by centrifugal force.

In 1902 the writer tried the first idea and succeeded in making a very poor flat-flame mechanical atomizer by forcing the oil between two flat surfaces pressed closely together, and in 1907, when in answer to the Navy's call we took up the matter of mechanical atomizing seriously, we tried some of the other schemes. The experiment of making two round jets of oil strike each other on the principle of the acetylene burner, resulted very interestingly in flat spray—not fine enough, however, with heavy oils to be practicable. A mechanical atomizer, or, as it was called, a "self-atomizer," consisting of eight small jets meeting at a central point, was patented in England in 1904 by Charles Ferdinand de Kierskowski Steuart. It is a good example of spraying by forcing jets of oil to strike each other, but otherwise has attained no importance in the art.

The only method of atomizing fuel oil mechanically which has attained any practical success is that wherein the oil is given a whirling motion inside the burner tip. There are two distinct means for doing this, first, by forcing the oil through a passage of helical form, like a screw thread, and second, by delivering the oil tangentially to a circular chamber from which there is a central outlet. Examples of the first form are shown in the

*Abstract of a paper presented before the Society of Naval Architects and Marine Engineers at its annual meeting, November, 1912.

†Mechanical Engineer, Marine Dept., Babcock & Wilcox Co., 85 Liberty St., New York City.

spraying burners perfected by Schutte and by Howden and illustrations of the second form are given in those perfected by Jones and by Stringham and Elmendorf.

The matter of adjustability of an oil burner, that is, the ability to change the quantity of oil delivered in a given time without changing the oil pressure or the velocity of the liquid through the tip, while attractive in idea and perhaps well sustained in theory, has no particular value in practice. It is a fact that in regular operation on shipboard, the simpler forms of burners which do not possess this feature are quite as successful, if not more so than those possessing it. The manipulation of the oil pressure acting on all burners at once presents in itself a simple means for the control of output through a wide range. A good burner will atomize moderately heavy oil with an oil pressure as low as 30 lb. per sq.in. and from that up to 200 or above. If this range is insufficient to meet the variable steam requirements, then it is easier and better to shut down a portion of the burners entirely than to attempt to adjust each

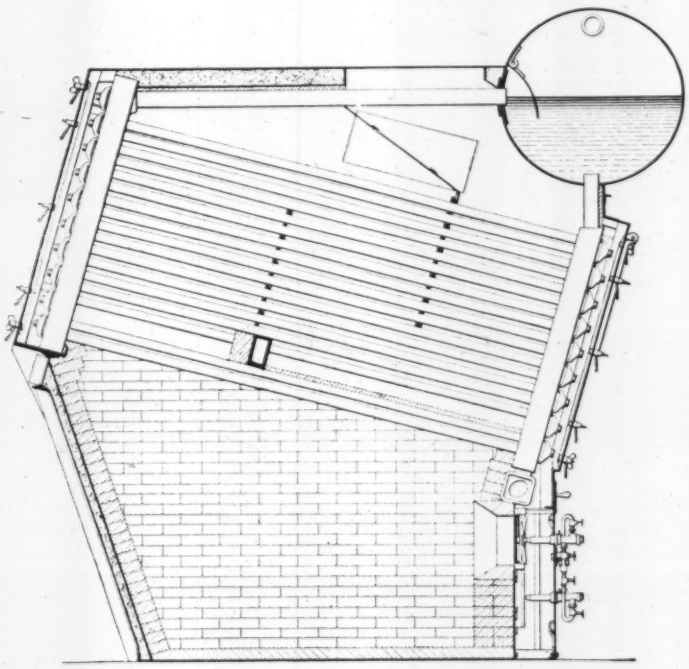


FIG. 3. CROSS-SECTIONAL SIDE ELEVATION OF A MARINE BOILER FITTED FOR BURNING OIL FUEL

individual burner separately, particularly as it is important to regulate the quantity of air admitted to the furnace for combustion, at the same time the quantity of oil is varied.

This air supply can be easily controlled for all burners by regulating the draft pressure, and the air can be closed off entirely when a burner is shut down. This puts the question of proper air supply more into the hands of the designer, requiring the operator to determine only the proper conditions of draft pressure for the plant as a whole, at the required capacity.

Another means of varying the quantity of oil delivered by all burners in addition to alteration of oil-pressure is available in alteration of oil temperature. Generally speaking, under working conditions any increase in temperature of the oil results in decreased capacity of the burners, the pressure remaining the same. The reverse is the case at low temperatures, the critical point depending on the relationship between viscosity and specific volume of the oil in question.

This law is shown graphically in the diagram in Fig. 1, giving the results of a test on a sample of Texas oil of 18° gravity (degrees Baumé) and a flash-point of 240° F. The oil pressure was maintained constant throughout the test at 200 lb. per sq.in and the temperature was raised by stages from 80° F. to the flash-point. The burner capacity increased rapidly up to a temperature of 110° where it reached a maximum. With continued heating it began to fall off and continued to do so throughout the range of the experiment.

It will be obvious, if oil is to be atomized by centrifugal force, that the best spray will be obtained by giving the oil the maximum whirling motion and reducing to a minimum the friction in the burner so that the whirling motion once obtained shall not be diminished before the oil is liberated. These are axiomatic principles, recognized by all, and no doubt each inventor believes he has best met the requirements. Probably these three questions are the controlling factors in the "survival of the fittest."

(1). How heavy an oil will a burner thoroughly atomize?

(2). What pressure and temperature are necessary?

(3). What degree of simplicity has been attained in the design?

It may be said here that any apparatus which will not handle heavy oil will have a very limited usefulness. Already the market is beginning to be supplied with very heavy oils from Mexico, there is a considerable amount of crude oil in California below 15° gravity, and the tendency will be more and more to use the heavier residuums. Probably in a few years we will be using oils of 12° to 15° Baumé as commonly as we are consuming oil of 27° to 30° gravity today.

There was recently received, for experimental purposes, some Mexican crude oil having the following characteristics;

Specific gravity at 60° F.	0.981
Degrees Baumé at 60° F.	12 6
Moisture and silt	3.5%
Flash-point	310° F.
Burning point	347° F.
B.t.u. per pound (oil as received)	17,551

In appearance this oil was black and at temperatures of about 80°, very sticky and viscuous. On heating to 212° it turned to foam owing to the presence of so much water, and this failed to separate out, a sample of the oil being thinned down with ether to determine the percentage. Ordinary settling tanks would have been practically useless, as the oil was so near the specific gravity of water. This oil was, however, successfully sprayed and burned under natural draft, on being heated to 270° at a pressure of 165 lb. per sq.in. A slight amount of smoke was formed which disappeared on a slight increase in the furnace draft above 0.12 in. of water. The most noteworthy feature of the experiment was that the capacity fell off about 40% from that obtained with the same apparatus with oil of 18° gravity. This sample of oil was the worst the writer has ever seen, but it is a specimen of what we may have to handle in the near future.

In the light of some experiments begun in 1907 we have come to believe that the best rotative effect on the oil is produced by the tangential delivery method, and it seems plain that the best way to reduce friction is to reduce the amount of surface to which the oil is exposed in its travel through the burner after it begins to whirl and until its exit from the tip. We have also come to attach great importance to simplicity in everything connected with oil burning and to believe that the oil burner itself should be of simple construction, easily taken apart, and

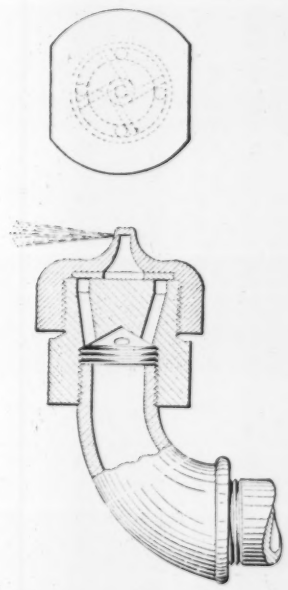


FIG. 4. PROPOSED FORM OF FLAT-SPRAY MECHANICAL ATOMIZER FOR USE WITH OIL FUEL

so designed that when taken apart all the small passages and wearing surfaces will be exposed for inspection, cleaning and repair.

The results of the writer's efforts to construct a burner to meet these requirements are shown in Fig. 2. Oil is delivered under pressure to an annular channel cut into the face of a nozzle upon which is screwed a tip having a very small central chamber communicating with a discharge orifice. Between the nozzle and the tip a thin washer or disc is inserted and held firmly in place. This has a hole in its center corresponding with the diameter of the central chamber of the tip, and small slots or ducts extend tangentially from the edges of the central opening outward toward the periphery of the washer, long enough to overlap the annular channel of the nozzle and put it

in communication with the central chamber. When this burner is assembled with the washer in place, oil is delivered through the ducts tangentially to the central chamber where it revolves rapidly and is almost immediately discharged through the orifice in the tip.

In order to correct a popular fallacy, attention should be called here to the fact that no mechanical atomizer produces a revolving spray, but the particles of oil fly off in straight lines under the influence of centrifugal force, thus forming a hollow, conical spray. The fineness of this spray, that is, the minuteness of the particles forming it, has a most important bearing on the results obtained in the furnace. It is possible with some forms of steam atomizers to atomize oil so finely that no flame at all will be produced, the incandescent combustion chamber being filled merely with a clear, invisible gas and every brick being discernible. It is doubtful if this condition of flameless combustion can be produced with mechanical atomizers and heavy oil, nor is it desirable under any circumstances for the simple reason that it costs too much.

With the production of flame, however, furnace design assumes an added importance, for the flame must be distributed evenly and without localizing on the heating surfaces of the boiler, and the gases must be given time and space in which to expand and burn as nearly as possible to completion before being cooled and the flame extinguished by contact with the tubes of the boiler. These points become exceedingly vital when the boiler is forced to the requirements now demanded in naval service.

Having an atomizer, therefore, that will produce a fine spray with heavy oil and which is simple, reliable and easily handled, the problem becomes one, not of oil burner, but of furnace design and air distribution. Our work has been carried on, until recently, entirely with the Babcock & Wilcox marine boiler, a design having a furnace ideally suited for any volatile fuel and particularly for oil. A longitudinal section through this boiler fitted with mechanical atomizers is shown in Fig. 3. It will be seen that the characteristics of this furnace are; large volume in proportion to the heating surface of the boiler; upward slope of the roof toward the rear, resulting in increase in height and volume in the direction of the entering oil spray and thus providing room for the expansion and diffusion of the gases; small amount of boiler heating surface exposed, and, on the contrary, large exposed surface in incandescent refractory material, thus tending to maintain high furnace temperature and promote complete and rapid combustion of the oil; tubes almost parallel with the path of the oil spray injected into the furnace from the front, thus promoting proper distribution of the gases along the tubes and preventing local overheating; outlet from the furnace at the point most remote from the location of the atomizers, thus insuring long travel of the gases; and, finally, means for bringing the heated products of combustion into the closest possible contact with the entire amount of heating surface of the boiler, discharging the waste gases into the uptake at temperatures but little above that of the steam generated. These conditions combined to relieve us of any worry about furnace design.

The experiments therefore developed principally into a search for the best-method of admitting the air for combustion, in which process great delicacy is required. Very slight changes affect the results in unsuspected ways and while almost any method may result in smokeless combustion, maximum economy and capacity can only be secured by careful and intelligent design. It is not necessary to give the air a whirling motion, but judging from our rather exhaustive experiments better gas analyses are secured, lower air pressures are required and less refinement of adjustment is needed if the air is brought into contact with the oil spray with the right sort of twist.

Mention has already been made of the special advantages of flat spray atomizers, and the many forms of successful steam atomizers which give a flat flame, warrant the belief that there is a wide field awaiting a thoroughly satisfactory flat spray mechanical atomizer. Reference has also been made in a previous paragraph to a flat flame atomizer, formed of two flat surfaces pressed together, and to another consisting of two round oil jets striking together. Neither of these schemes seems to promise very much in the way of material for development. Another form which does seem to possess some merit, however, is illustrated in Fig. 4. This consists of a means for giving the oil a rapid whirling motion as in the case of the round flame burner and then releasing the liquid through a slot in the side of the tip in a plane at right angles with the axis of revolution instead of through an orifice concentric with the axis. It is apparent that centrifugal force will here come into action as an atomizing agent but that the spray will be flat instead of conical.

The only practical flat flame mechanical atomizer which has been put on the market is that brought out by the Schutte-Koerting Co. and installed by them on the U. S. S. "Utah." This burner is simplicity itself—a very considerable advantage—and the spray is excellent at low powers. About the only limitation which has been discovered in this burner is the fact that at anything over about 100 lb. of oil delivered per hour, the spray loses its finely diffused character.

An effort has been made to show that while the problem of oil burning presents some difficulties, particularly as regards admission of air, there is very far from being any mystery about the matter. A strong leaning toward simplicity, "horse sense" and some experience, are a combination reasonably sure of giving good results, without depending very much on abstruse reasoning or higher mathematics. Improvements will be required and will be forthcoming, particularly in connection with spraying the heavier oils and the flat spray atomizer has a promising field for development. Meanwhile the results already attained are certainly encouraging.

Air as a Stimulator of Corrosion in Refrigerating Systems

By M. B. Smith*

The paper on "The Design of Hot-Water Supply Systems, especially to those parts of the apparatus which con-NEERING NEWS, Feb. 13, presents many valuable suggestions for the proper design of such equipment so that the danger of accelerated corrosion by the action of air (oxygen) may be minimized.

The suggestions contained in this very timely paper are equally applicable to the design of refrigerating systems, especially to those parts of the apparatus which contain or transmit brine or ammonia, in either gaseous or liquid form.

As early as 1905, the danger due to the acceleration of corrosion by the action of air, either entrained as gaseous particles or in solution in the brine, was pointed out by the writer after a very thorough investigation of a severe case of corrosion throughout the refrigerating system in one of the large office buildings at Pittsburgh. The system in this building furnished refrigeration to a café on the ground floor, to a restaurant, and to a club on the top floor, 22 stories above ground. There was also cold drinking water running on every floor.

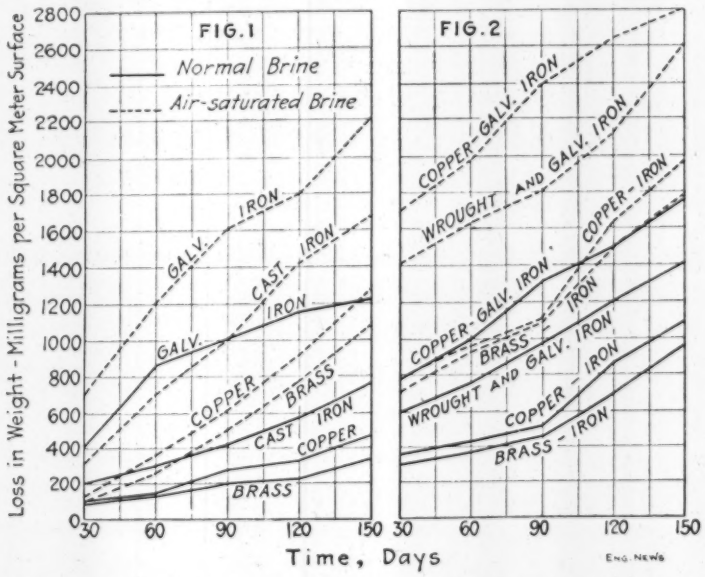
All of this large system was more or less affected by corrosion, the corrosion appearing almost without exception at fittings, valves and pumps. The corrosion was more or less localized at these places and always appeared within the piping or fittings and at the top. All conditions, excepting only the electrical differences of potential found on measurement, pointed to the presence of air either entrained in the apparatus or in solution in the brine itself. Experiments were then started to determine whether or not air was entrained in the apparatus, the first step being to locate the highest point of the apparatus. This being done holes were drilled through the piping and pet-cocks were placed at these points. When the drills broke through the piping there was invariably a rush of air from within. It was proven beyond a doubt that the apparatus had never since its installation been filled completely with brine. The system then was filled completely with brine after placing pet-cocks at all high points throughout the entire refrigerating system. These cocks were then closed but remained in readiness to vent the apparatus periodically, and to make it possible thoroughly to fill the brine-carrying parts of the installation.

It is a very significant fact that the worst corrosion by far was manifest at the very topmost part of the system, showing that air, when entrained as such, works

*Chief Chemist and Combustion Engineer, Detroit United Rys., Detroit, Mich.

along to high points and that it is perfectly feasible to vent such apparatus and prevent accelerated corrosion at such places. In this case there is absolutely no doubt that corrosion was greatly diminished by remedying this fault.

There was still another phase of this question of air in this particular system, namely, that held in solution in the brine. Examination of the brine-carrying parts, especially the return-brine lines, showed that there was an excellent opportunity afforded for the liquid to become thoroughly saturated with air. The brine returning to the main supply tank in the lowest basement fell through air a distance of some 5 to 6 ft., churning up the brine in the tank and being itself more or less sprayed during its fall. Examination of the brine showed that it carried an abnormal content of dissolved air and showed plainly that something must be done at once to minimize this absorption. Accordingly the return pipe was lengthened so that the brine discharged about 8 in. below the surface of the liquid in the tank. This did not put sufficient back-pressure on the system to be noticed at all in the operation. Examination of the brine after some weeks of operation showed a content of air not over a tenth of



FIGS. 1 AND 2. RESULTS OF CORROSION TESTS OF SINGLE- AND TWO-METAL TEST PIECES IN ORDINARY AND AIR-SATURATED BRINE

that before making the above change in the piping. The thought came at once that experiments along this line should develop data of value as confirmatory evidence of the facts noted in practice.

Experiments were started in which single metals and combinations of dissimilar metals were partially immersed (⅝ only) in a commercial brine, consisting of calcium chloride, of a strength equivalent to 1.2 specific gravity. The temperature of the tests was from 20° to 25° (room temperature). The duration of the tests was 150 days, sufficiently long to establish the general behavior of the metals. One set of test pieces were placed in normal brine; the second set being placed in the same brine after saturating it with air.

The writer believes that the results are typical for the conditions maintained; he realizes that such results are purely comparative, not absolute, for a change in the metals used would undoubtedly alter the results and other factors are to be considered, such as auto-electrolysis, etc., which would have their effect in experiments of this sort. The fact is established, however, that air-saturated brine is relatively much more corrosive than brine carrying only a normal amount of air in solution. It is, therefore, highly probable that if refrigerating apparatus were designed to remove air from the system, just as far as is practicable, one of the most highly corrosive agents known will have been eliminated and corrosion undoubtedly minimized.

The experiments were carried out with various metals partially immersed in brine. Test pieces were 6 in. long, 3 in. wide and ¼ in. thick. These were polished smooth at the start before weighing. At certain intervals the test pieces were removed from the brine, rubbed in hot water with a soft brush to remove any easily loosened oxide and weighed after drying in alcohol. The pieces were only partially immersed since this simulates a condition always found in practice. It is also more severe than complete immersion would be under identical conditions. The results are tabulated in the accompanying table and plotted in the accompanying figures. Losses are expressed in milligrams per square meter of surface immersed.

RESULTS OF EXPERIMENTS ON THE ACTION OF BRINES ON METALS

(Loss in Milligrams per Square Inch.)

Single Metals

	Normal brine					Air-saturated brine				
Days	30	60	90	120	150	30	60	90	120	150
Copper	100	150	280	330	470	130	360	605	905	1270
Iron (cast)	200	300	420	575	760	310	700	1000	1420	1680
Brass	80	130	198	230	340	100	260	500	765	1080
Iron (galv.)	400	860	1000	1150	1220	700	1200	1605	1890	2210

Combinations of Dissimilar Metals

	Normal brine					Air-saturated brine				
Days	30	60	90	120	150	30	60	90	120	150
Copper / Iron	360	430	520	860	1090	786	962	1110	1636	1980
Brass / Iron	300	365	465	695	960	710	925	1090	1492	1785
Wrought iron. / Galv. iron	600	760	970	1200	1410	1410	1625	1810	2130	2605
Copper / Galv. iron	780	1000	1310	1500	1760	1700	1980	2400	2650	2810

The increased rate of corrosion, due to air-saturation of brine, is marked in both single metals and in combinations of dissimilar metals. The figures for the combinations of dissimilar metals cover the loss of both metals but it is probable that this was very largely confined to the iron or galvanizing (zinc) on account of active local electrolytic action.

In so far as was possible conditions were maintained alike in all experiments excepting only the amount of air in solution in the brine. The widely different results in the case of normal and of air-saturated brine may be laid to the different amounts of air in solution in the brine. The writer is of the opinion that the designers of refrigerating apparatus should make an earnest effort to so design their apparatus that the amount of air entrained in the apparatus or in solution in the brine may be kept at a minimum constantly. In bringing the results of this investigation forward the writer hopes that the data contained therein may be of practical value to those engaged in the design of operation of refrigerating apparatus.

❖

Purchase of Street Railway Power has been arranged by the Scranton Ry. Co. with the Scranton (Pennsylvania) Electric Co., the arrangement becoming effective Oct. 1, and running for 20 years. The present load runs from 5000 to 6000 kw. The electric company will take over the existing station (1500-kw. noncondensing) of the railway company on lease, together with a culm bank owned by the latter. The cost of railway energy at the switchboard of the old plant was about 0.8c. per kw.-h., with fuel from the culm bank costing 50c. per ton at the station.

Smoke-Washers for Roundhouses

SYNOPSIS—The smoke nuisance is an important factor in the relations between railways and municipal authorities, and the accompanying article describes a plant which has been put in service to reduce this nuisance by washing the smoke discharged from locomotives in the engine house.

✣

One phase of the smoke-reduction problem in cities is the nuisance caused by smoke discharged from locomotives in the engine houses, especially when the engine fires are being lighted. This nuisance is of special importance when the roundhouse is adjacent to a residence district. The ordinary arrangement is to place a smoke-jack or short smoke-stack over each pit or engine track, the engines being spotted with their smoke-stacks immediately under the flaring hood which forms the lower end of the jack. In this way the smoke is discharged at an elevation little above the roof of the engine house, so that it is much more liable to be a nuisance than smoke discharged from a tall chimney.

The use of smoke-ducts with exhaust fans, delivering the smoke from all the jacks to a single flue and chimney has been proposed (ENGINEERING NEWS, Oct. 24, 1912), but we are not aware of any such installation. Even this arrangement, however, would only reduce the nuisance, and would not eliminate it. The plant described below is intended to practically eliminate the nuisance. In brief, it consists in connecting the individual jacks to a single flue with branches leading to exhaust fans from which the smoke and gases are delivered to washers, beyond which is an escape chimney (one to each set of washers). The number of fans and washers will depend upon the number of engines. This system is the invention of O. M. Foster, Master Mechanic of the Lake Shore & Michigan Southern Ry., and for information regarding it we are indebted to Mr. McBain, Superintendent of Motive Power. It has been installed at a 30-stall engine house at Chicago, this engine house being at Englewood, a residential district. It is estimated that it will remove practically all of the unconsumed carbon and 75% of the acids and gases in the smoke.

From the general plan in Fig. 1 it will be seen that two branch flues are to be connected to the main smoke

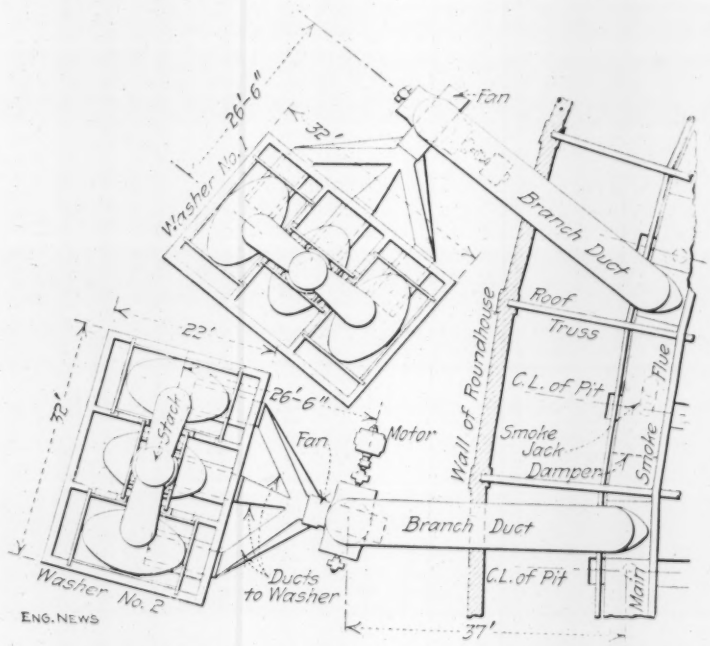


FIG. 1. PLAN OF SMOKE-EXHAUSTING AND SMOKE-WASHING PLANT AT THE ENGLEWOOD (CHICAGO) ROUNDHOUSE OF THE LAKE SHORE & MICHIGAN SOUTHERN RY.

flue, each branch leading to a motor-driven fan and a pair of three-compartment washing tanks. The smoke is drawn from the main flue by the fans and is discharged through a three-leg discharge pipe sloping downward to the washer compartments. Across the base of each compartment extends a horizontal flue, from the inclined dis-

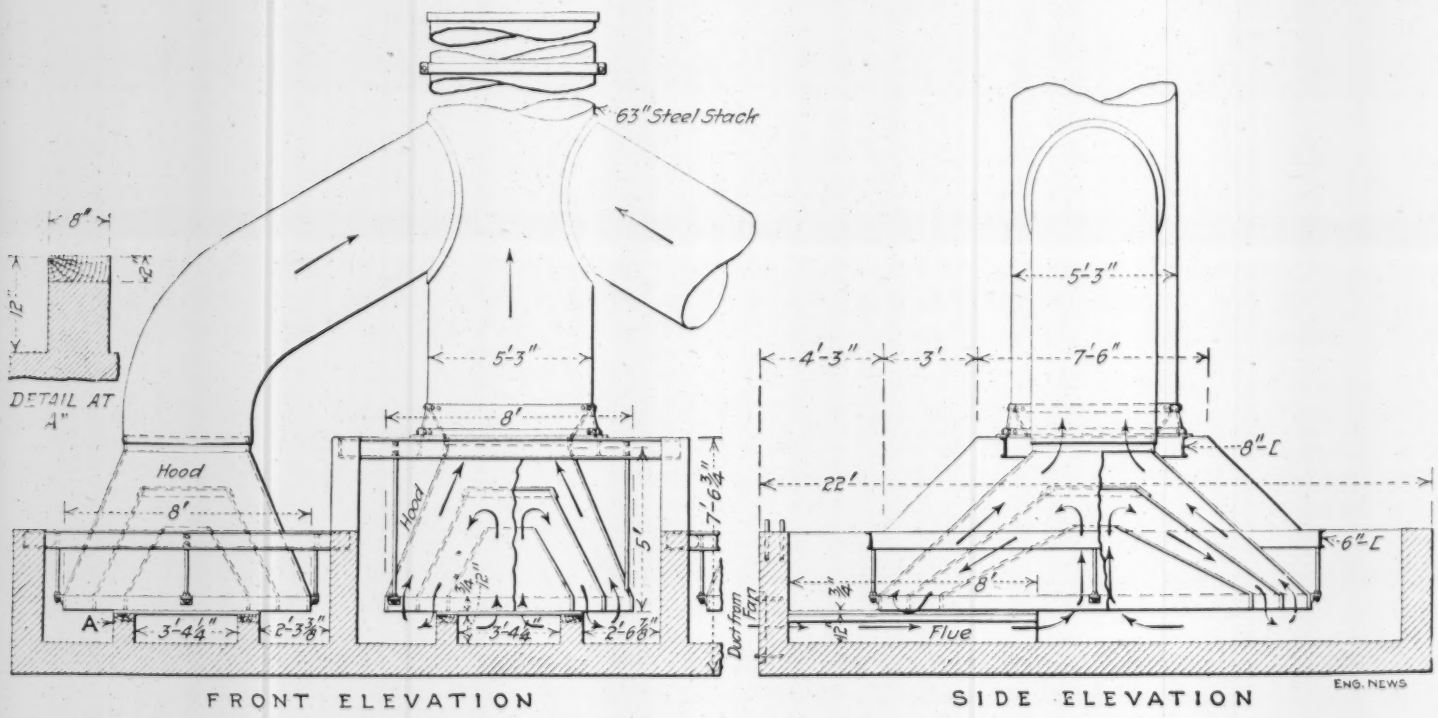


FIG. 2. SECTIONAL ELEVATIONS OF SMOKE WASHER FOR ENGINE HOUSE

charge pipe, and the compartment is filled with about 13 in. of water, the water level being about 1 in. above the top of the flue. At present, only one branch, fan and washer have been installed since the scheme is still on trial.

The smoke is discharged into this body of water, the velocity being sufficiently low to prevent undue agitation. It passes up through the water and escapes into the inner hood, from the top of which it passes into a duct leading it again into the water, from which it arises a second time into an outer hood. This is connected to the exhaust duct, which leads to a steel-plate chimney 63 in. diameter and 64½ ft. high above the ground. There is one chimney to each washer. The water in the washers is intended to be kept in constant circulation.

The hoods in this case are of steel, the plant being somewhat experimental as to details, but it is proposed to have the permanent plant built of concrete, in order to resist the corrosive action of the sulphurous gases. The ducts are of asbestos board and partly of steel. The fans are of ordinary steel-plate construction, 72-in. diameter, and are driven by constant-speed motors, the fans

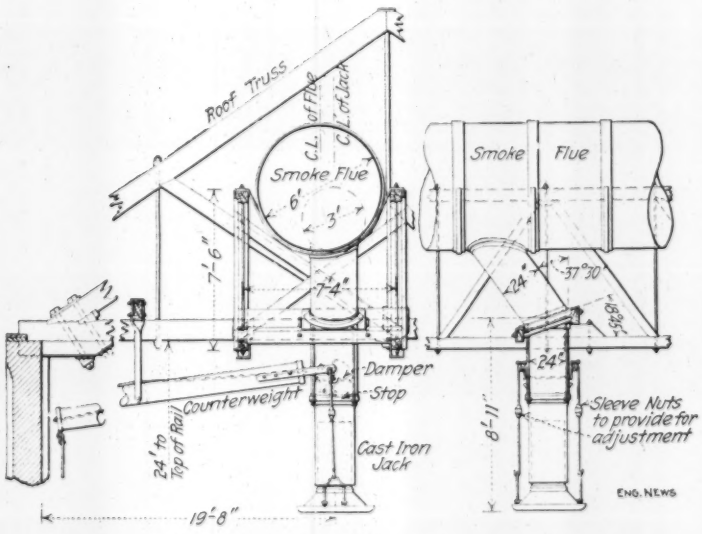


FIG. 3. SMOKE-JACK AND CONNECTION TO SMOKE-EXHAUST FLUE

making about 1120 r.p.m. The capacity of each fan and washer is estimated at about 60,000 cu.ft. of air or gas per minute. At some point between the fan and the tank, a jet of steam is introduced into the discharge pipe, the jet blowing in the direction of the flow of gas. This is found to aid materially in the washing process, as when the smoke is mingled with the steam, the particles of unconsumed carbon are removed by the water much more readily.

In the engine house, it is necessary to have smoke-jacks fitting closely to the engine stacks, to prevent any escape of gas and smoke. These smoke-jacks are shown in Fig. 3. They are of the drop or telescopic type, and have allowance for a slight swinging motion at the bottom, so that the jack can be connected to the engine smokestack without the necessity of spotting the engine directly under the center of the jack. The smoke-jacks are of cast iron, and it will be seen that they are supported independently of the smoke flue, which is of asbestos board and not designed to sustain appreciable loads.

The Washington Workmen's Compensation Act and the Results of Its First Year of Adminstration

By E. R. W. ALLISON*

As the writer believes that results attained in a twelve-months operation of the Washington Workman's Compensation Act show the possibilities of an adequate law for the protection of employer and employee properly administered, the following notes have been arranged from studies made while on the Pacific Coast.

The Industrial Insurance Commission (a body of three appointed by Governor Hay to carry out the act) has, through the thorough provisions of the law, been enabled to render effective service at minimum cost. The advantages evident are (1) increased safety in industrial operations, (2) sure and determinate relief for injured workmen and their families or dependents, and (3) the elimination of extended litigation with the consequent saving of retaining fees, court expenses, and the like.

This compensation law, authorized by the legislature in 1911, became operative Oct. 1 of that year; it applies particularly to extra-hazardous occupations, segregating such under 47 distinct classifications. These in general include such activities as railroading (steam and electric), general building, electric-light and power service, telegraph and telephone service, steamboat transportation, manufacturing (with machinery), founding, quarrying, mining, powder-making, smelting, hoisting, docking, dredging, logging, lumbering, ship-building, brewing, printing, and miscellaneous engineering.

The following important provisions, bearing particularly upon the effective operation of the act, are given as initially incorporated and covering the creation of an accident fund for indemnity to injured workmen as well as the schedule of such payments.

Each industry shall contribute a certain percentage of its pay-roll to compose an accident fund. Such premium is different for each class and is established therefor. This is payable to the State monthly until such time as there is a sufficient amount on deposit with the State to provide for the accidents in that particular class; at such time the assessments cease until the accidents occurring therein deplete its fund. Each industry is responsible only for the accidents in its class, and the accident fund is arranged to be neither more nor less than self-supporting; no money from this fund is used for the expenses of the Commission, a State appropriation of $150,000 for a specified time providing for such expense. The assessment rates are subject to revision and readjustment, depending upon the number of accidents and the consequent compensation demands for injured workmen.

The Commission is empowered to increase the rate of premium of a particular industry or firm which operates its business in a notably careless or negligent manner, compelling by such means a closer observance of factory laws and regulations on the part of the offender.

No part of any premium can be deducted from the wages of the workman; a violation of such by the employer is made a gross misdemeanor, punishable by one year in the county jail or a fine of $1000, or both.

Employers are required to report accidents promptly, and their books, records and pay-rolls must be open for inspection by the Commission at all times; refusal to permit such inspection is made a misdemeanor, with a penalty of $100 for each offense. Any misrepresentation in his pay-roll makes the employer liable to ten times the difference between the correct and incorrect figures. If an employer refuses or fails to pay his monthly assessments, a workman injured in his service may sue in the courts with the employer's defenses of "fellow-servant," "assumption of risk," and "contributory negligence" abolished.

Injured workmen, their families or dependents, may re-

*170 Roseville Ave., Newark, N. J.

cover by law only where the injury is caused by the intent of the employer, in which case not only may the sums due under this Compensation Act be recovered, but suit may be brought for excess of damage over such amounts.

Where the injury to a workman comes as a result of negligence of the employer to observe safeguards as required by law or by the regulations of the department, the employer must pay 50% more than the fixed amounts. Where the workman intentionally injures himself he receives no benefit.

The schedule of payments for various injuries is as follows: In event of death, expenses of burial, $75; payments to widow or invaid widower, $20 per month while unmarried, $240 in lump sum on remarriage of widow, for each surviving child under 16, $5 per month, monthly total limited to $35; if no widow or widower survives, $10 per month to each child under 16 years of age. A like rule obtains to children who become orphans by death of surviving parent, with monthly limit of $35. Dependents will be paid 50% of the average monthly support formerly received from the deceased, limited to $20 per month. Parents of deceased unmarried workmen receive $20 per month up to the time deceased would have been 21 years of age.

Total disability, loss of both arms or one leg and arm, sight, paralysis, or other injury preventing work, entitles the workman to $20 per month if unmarried; if supporting wife or invalid husband, $25 per month; if husband is not an invalid, $15. For each child under 16, $5 per month additional is allowed up to a total of $35 per month. In case of death of the totally disabled workman, the widow or widower receives $20 per month until death or remarriage, and $5 per month additional for each child under 16. Orphan children receive $10 per month.

Partial disability, loss of one foot, leg, or hand, eye or fingers, entitles the workman to a certain cash lump sum up to $1500. The loss of one arm at the elbow is made the maximum injury, and the payment for other injuries is scaled down in accordance. Should the injured workman reside or move out of the State, the Commission may lump the monthly payments to a sum not to exceed $4000, based on the American mortality table.

Any decision of the Commission is subject to an appeal in the superior courts.

WASHINGTON INDUSTRIAL INSURANCE COMMISSION: EXPENSE ACCOUNTS

Mileage:		
Commissioners	$1,298.10	
Auditors	1,248.23	
Railroad fare:		
Commissioners	1,022.84	
Auditors	3,147.88	
Hotel account:		
Commissioners	1,638.44	
Auditors	4,722.34	
Incidental expenses:		
Commissioners	36.60	
Auditors	224.18	$13,338.61
Salaries:		
Commissioners	14,190.00	
Auditors	25,499.47	
Physicians	4,653.55	
Office	28,499.51	72,842.53
Miscellaneous:		
Stationery	6,251.13	
Postage	4,354.53	
Telephone	716.93	
Telegraph	110.66	
Office equipment	7,371.58	
General expenses	1,032.61	
Rent	1,849.50	21,686.94
Total expenses for period		$107,868.08
Accident payments		445,527.51
Total		$553,395.59
Total State Appropriation for 22 mo.		150,000.00
Allowable average monthly expense		6,818.18
Actual average expense for 16 mo.		6,741.75
Allowable total expense for 16 mo.	$109,090.88	
Actual total expense for 16 mo.	107,868.08	
Saving over allowable average	1,222.80	
Average allowable to exhaust fund		7,021.99
Actual total expense for September (last month of period)		6,437.77
Total receipts, accident fund	$980,445.75	
Total expense	107,868.08	
Total fund		$1,088,313.83
Cash in fund, 26.8%	290,933.29	
Reserve fund, 22.4%	243,984.95	
Claims paid, 40.9%	445,527.51	
Expense paid, 9.9%	107,868.08	
100%		$1,088,313.83

First Year of Operation of Act

The accompanying table of accounts covers the total expense of the administration of the compensation law by the Industrial Insurance Commission for a period of 16 months, four of such being for preliminary work previous to the perod of active operation. The data has been obtained from the recent report of Howard L. Hindley, secretary of the commission.

From this statement it will be seen that the Commission is administering the law at a cost of 9.9%, obtaining such a low operation cost during its initial year despite the expense of inaugurating the system, the contingent cost of permanent office equipment, and the necessarily heavy traveling expenses.

The assessments against the various classified industries netted the accident fund during the first four months of active operation, $428,057.42; by a resumption of logging and mill enterprises in April, 1912, this was increased to $640,951.30, while the close of the first fiscal period effected a gross total collected of $980,445.75.

The first year's records show a gross expenditure of $689,512.46; of this, the sum of $445,527.51 was paid out directly to injured workmen and their dependents, with the elimination of litigation expense or excessive cost to the State at large; and $243,984.95 was invested in State school, county and municipal bonds, and the like, bearing an average rate of interest of 5¼%, to guarantee the payment of pensions now being distributed monthly to injured workmen.

A comparison of these figures with available statistics of private casualty insurance in the state is interesting. Against the expense of 9.9% as cost of operation to the state, the private casualty company is estimated to expend 60%; under such a private system of insurance, about $600,000 was collected annually from the manufacturing interests in the state with an average return of less than $100,000 to injured employees.

Insurance Cost to Employers

Continued Assessment of Contractors—In the first eight groups of classified industries, dealing with contractors and contracting, no insurance rates have been extended, but assessments are continuously made. Such system prevails for the following reasons:

(1) The extreme hazard of all operations in these classes demands a wide margin of safety.

(2) Among these classes there is none which has a sufficient balance to allow a point of reasonable safety in connection with a series of fatal accidents.

(3) Without continuous assessments the small contractor might easily escape payment on his short-term contracts.

(4) Accidents in these classes have been continuous, and assessments would necessarily have been levied finally to defray accident costs. With such conditions, the larger contractor, being well established and readily accessible, would have been compelled to bear the cost of not only his own accidents but also those occurring on the work of the smaller contractor who might have escaped assessment.

(5) The placing of contractors on the same plane for the purpose of bidding for contracts, demands that every contractor shall be assessed on every job.

(6) The general contractor is found listed in several classes—big work, small work, public work secured by

law, private work where the owner may be subjected to loss, and the like. Hence the equitable system appears to be that of continuous assessment until the fund may reach that figure where all can consistently be relieved.

The law, providing as it does for a readjustment of accounts each year, makes possible the correction of inequities or over-payments with but slight delay.

The need of legislation to cover "casual employment in contracting" has become evident. All such operations, as the erection of a barn, the construction of a temporary grand stand, the painting of a house, etc., are now difficult to list and assess, while additionally, the Commission rarely learns of them until an accident occurs, at which time both employer and employee make haste respectively to contribute and to demand compensation.

A typical instance of this is shown in the contribution of $3.85 by an employer, after a carpenter had lost his eye through a flying nail, while the accident cost the employers of that class $1,064.60.

Insurance Cost in Principal Classes—In the main, active classified industries of the state the cost of insurance to employers during the first fiscal period has been as follows:

Industry	Rate per $100 fixed by law	Rates per $100 assessed	Rates per $100 necessary
Class 10, logging, lumbering, etc.	$2.50	$1.45	$1.45
Class 14, street railroading	3.00	0.75	0.23
Class 16, coal mining	3.00	1.50	1.23
Class 33, fish canning	3.00	0.75	0.14
Class 35, brick making	2.00	0.50	0.13
Class 38, textile manufacturing	1.50	0.38	0.12
Class 39, food-products manufacturing	1.50	0.38	0.09
Class 40, butter and cheese making	1.50	0.38	0.05
Class 41, printing	1.50	0.38	0.07
Class 44, ice making	2.00	0.50	0.27
Class 47, creosoting	2.50	0.61	0.18

Class 10; Logging, Lumbering—The fund obtained through a seven months' assessment of this class ($324,102.86) has been depleted by the payment of claims amounting to $206,146.50, and the investment in reserves has been $117,366.32, leaving a net balance of but $590.04. The size and activity of this industry make an early replenishing of this fund possible, and a second assessment call is now in progress.

Class 46; Powder Mills—The funds of this class have been overdrawn, due to the noncollection of assessed contributions. A rate of 5% of total payrolls instead of the 10% assessed would have been sufficient, with proper collection, to defray the compensation for accidents in this industry, including the disaster at the plant of the Imperial Powder Co., Chehalis, on Nov. 1, 1911. A statement of this class will show a balance when paid as below:

Ten per cent. of payrolls, Oct., Nov., Dec.	$3,956.49
Deficit, Jan. 1, 1912	4,302.86
Ten per cent. of payrolls, Jan. 1 to Oct. 1	11,811.99
Total	$20,071.34
Less pension reserves, and burial allowances	8,259.35
	$11,811.99
Penalty on Imperial Powder Company for employing two girls under lawful age	1,297.16
Balance (when collected)	$13,109.15

Number of Pensioners

The pension roll has increased from the first pensioner in October, 1911, a widow and her son with a monthly income of $25 guaranteed by the state, to 235 persons at the end of the first fiscal year, including widows, helpless parents, and fatherless children with a total monthly distribution of $2,364.50.

The death claims brought to the attention of the Commission are in process of settlement as follows:

Pensions awarded	121
Suspended and rejected (no dependents)	191
In state of investigation	38
Incomplete	22
Total	372

Statistics on approximately 1000 cases brought before the Commission show that less than 3% of the accidents reported under this Workman's Compensation Act would be applicable to liability under the former law, effecting a total of about 97% of all the above cases probably uncompensated under the casualty-insurance system.

During the first year of operation, 11,896 formal reports of accidents were received by the Commission. The monthly average of such has been on the increase since the inception of the law, owing to the resumption of business in certain lines and a more complete understanding of the compensation act and its province. In February, 1912, the accidents reported totaled about 800, while in September of the same year the reports reached nearly 1000.

Appeals

Only twenty-one appeals have been taken to the courts from the decisions of the Commission on the 11,896 accident reports mentioned. Three of these were later withdrawn, three were tried, and the balance are now pending. One appeal is by an employer, three are by dependents of workmen, and the remainder by the workmen themselves. In but two cases have permanent disabilities been found by a jury in contradiction to the Commissioner's decision.

Forty-three suits have been instituted against defaulting employers to collect premiums due to the accident fund. Of such number, 17 were settled previous to judgment, four subsequent to judgment, and in seven cases judgments have been awarded but not yet collected. Eliminating two cases discontinued (one because the plant was not in operation after Oct. 1, 1911, and the other for the reason that the employer had no one in his employ after that date) 13 of the suits are still pending.

Nonhazardous Class Protection

Under Section 19 of the Workman's Compensation Act, mutual protection is provided for a nonhazardous class, by which employer and employee may jointly elect to come within the jurisdiction of the law, although technically excluded by the nature of their business. The mutual protection provided is at a rate of $1.35 per $100 as fixed by the law.

Employers who took advantage of this "elective adoption" feature of the act paid a three-months' premium at the rate of 34c. per $100, effecting a total sum collected of $1,092.30. Of this fund only $83.95 was required for meeting accident-loss, making a necessary rate of but 3c. per $100.

During this period of administration of the act, the Industrial Insurance Commission has been composed of George A. Lee, of Spokane, Chairman (representing the legal profession), C. A. Pratt, of Tacoma (representing the manufacturers and employers), and J. H. Wallace, of Seattle (representing the workingmen). The writer is indebted to a recent report of the secretary of the commission, Howard L. Hindley, for data relating to the first year's work and from which the foregoing statistics have been summarized.

The Cost of Irrigation Works per Acre Supplied with Water

In the early days of irrigation in the arid West, the work was carried on at a very small outlay by the farmers and ranch owners themselves by the simple process of turning the natural flow of the streams upon their land. All such easily appropriated water, however, was utilized a score of years or more ago. Practically all the recent irrigation work has had to be done, either by bringing water from a long distance in large canals, tapping good sized rivers, or by building reservoirs to store the flow of the flood season. In this class of work again, however, projects involving the least outlay were taken up first. There has been, therefore, a tendency to a constant increase in the cost per acre of irrigated land in the new enterprises undertaken year after year.

Another reason for the increased cost of irrigation work is the advance which has taken place in the cost of both labor and material. Hon. F. W. Mondell, Congressman from Wyoming, stated two years ago in the discussion concerning the proposed authorization of a $20,000,000 loan for the U. S. Reclamation Service work, that the prices of common labor in the West advanced 20 to 50% in the period from 1903 to 1911, and that the efficiency of such labor fell off in greater proportion.

TABLE I. COST OF PRIVATE IRRIGATION PROJECTS

Name of project or company	Acreage in project	Cost of water right charge per per acre (a)	
COLORADO:			
Amity Canal	80,000	$100	(b)
Beaver Land & Irrigation Co.	20,000	175	(b)
Catlin Canal	25,000	100	
Colorado Coöperative Co.	5,200	60	
Denver Reservoir & Irrigation Co.	200,000	45	
East Palisade Irrigation District	645	63	
Fort Lyon Canal	70,000	100	(c)
Grand Valley Canal	40,000	60	(d)
Greely Poudre Irrigation Co.	125,000	45	
Mesa County Irrigation District	2,568	73	
Orchard Mesa Irrigation District	9,122	119	
Otero Irrigation District	20,000	40	
Palisade Irrigation District	6,000	41	
Paradox Valley Irrigation Co.	30,000	45	
Pueblo-Rocky Ford Irrigation Co.	100,000	150	(e)
Redlands Irrigation & Power Co.	5,000	100	(f)
Routt County Development Co.	39,000	45	
South Palisade Heights Irrigation District	700	127	
MONTANA:			
Conrad Land & Water Co.		40	
Great Falls & Irrigation Co.	36,000	50	
NEBRASKA:			
Belmont Canal & Irrigation District	20,000	25	(g)
Tristate Canal	60,000	42	
NEW MEXICO:			
French Land and Irrigation Co.	40,000	50	
OREGON:			
Bonanza Project	20,000	39	
Eagle Valley	21,700	80	
Furnish	6,000	60	(h)
Paradise	100,000	60	
Willamette Valley	20,000	50	
SOUTH DAKOTA:			
Red Water Irrigating Association	4,000	40	
UTAH:			
Provo Reservoir	12,000	80	
Utah Lake Pumping	8,000	40	(i)
WASHINGTON:			
Cascade Canal Co.	10,000	50	
Congdon Canal Co.	4,200	121	
Kennewick Canal	14,000	163	
Lower Yakima I. Co.	12,500	129	
Selah Moxie	7,000	86	
Selah Valley Development Co.	10,000	150	
Union Gap Irrigation Co.	5,000	135	
Washington Irrigation Co.	50,000	46	

(a) Engineers' estimates where project is proposed or incomplete.
(b) Estimated at from $75 to $150 per acre. Includes land.
(c) Estimated at from $75 to $150 per acre.
(d) Per miner's inch.
(e) Includes land.
(f) Estimated at from $56 to $150 per acre.
(g) For river rights only. Purchase of Pathfinder Reservoir water will increase this to $35.
(h) Estimated at from $50 to $70 per acre.
(i) Estimated at from $40 to $50 per acre.

To give a general idea of the cost of supplying water per acre, the U. S. Reclamation Service has recently compiled three tables, the first showing the cost per acre for water on private irrigation projects, the second the cost of the private irrigation projects carried out under the Carey act by various companies, and the third

TABLE II. COST OF CAREY ACT IRRIGATION PROJECTS

Name of project or company	Acreage in project	Cost of water right charge per acre (a)	
COLORADO:			
Great Northern Irrigation & Power Co.	2,121	$35	
Colorado Realty & Security Co.	45,875	45	
Toltec Canal Co.	14,853	40	
Colorado Land & Water Supply Co.	16,278	45	
Two-Butte Irrigation & Reservoir Co.	22,000	35	
Valley Investment Co	24,000	60	
IDAHO:			
American Falls Canal & Power Co.	57,242	40	
Big Lost River Irrigation Co.	78,242	40	
Birch Creek Irrigation Co.	20,000	50	
Blackfoot North Side Irrigation Co	22,280		
Black Canyon Irrigation District	98,492	72	
Blaine County Irrigation Co.	14,720	40	
Boise City Carey Act Project	151,000		
Bruneau Irrigation Co.	40,000	60	
Emmett Irrigation District	5,800	50	
Grandview Extension Irrigation Co.	1,000	65	
Grassmere Irrigation Co.	47,500	65	
Hansen, C. V., Mackay Project	3,456	40	
Hegsted, Victor, Project	3,410	40	
High Line Pumping Co., Ltd	3,860	45	
Houston Ditch Co., Ltd.	1,884	35	
Idagon Irrigation Co., Ltd.	9,000	60	
Idaho Irrigation Co., Ltd.	130,000	50	
Keating Carey Land Co.	15,597	30	
Kings Hill Extension Irrigation Co.	9,655	65	
Kings Hill Irrigation and Power Co.	13,359	65	
Lemhi Irrigation Co.	3,500	50	
Little Lost River Land & Irrigation Co.	20,000	30	
Marysville Canal & Improvement Co., Ltd.	6,134	20	
Owsley Carey Land & Irrigation Co.	8,600	35	
Owyhee Land & Irrigation Co.	29,535	55	
Owyhee Irrigation Co., Ltd.	3,296	45	
Pahsimerai Project	6,000	30	
Portneuf-Marsh Valley Irrigation Co.	11,914	35	
Pratt Irrigation Co., Ltd.	4,674	40	
Snake River Irrigation Co., Ltd.	6,500	50	
Thousands Springs Land & Irrigation Co.	6,300	30	
Twin Falls Land & Water Co.	244,000	25	
Twin Falls North Side Land & Water Co.	207,144	45	
Twin Falls Oakley Land & Water Co.	45,000	65	
Twin Falls Raft River Irrigation Co.	99,668	50	
Twin Falls Salmon River Land & Water Co.	127,707	40	
West End Twin Falls Irrigation Co.	46,000	50	
MONTANA:			
Billings Land & Irrigation Co.	27,000	40	(j)
Big Timber Project	17,194	60	
Valier Project	115,100	40	
OREGON:			
Central Oregon Irrigation Co.	139,204	40	
Central Oregon Irrigation Co.	74,198	60	
Columbia Southern Co.	27,000	50	(k)
Deschutes Land Co.	31,082	36	
Deschutes Reclamation & Irrigation Co.	1,280	40	
Desert Land Board	27,000		
Portland Irrigation Co.	12,000	46	
Powder Land & Irrigation Co.	65,000	100	(l)
UTAH:			
Mosida Pumping Plant	8,000	150	(m)
WYOMING:			
Big Horn County Irrigation Co.	20,411	50	
Boulder Canal	6,120	30	
Burch Canal	35,887	50	
Carbon County Land & Irrigation Co.	7,793	30	
Cody and Salsbury Canal	77,199		
Cody Canal	26,429	50	
East Fork Irrigation Co.	4,901	30	
Eden Land & Irrigation Co.	95,658	30	
Elk Canal	2,724	30	
Fisher Ditch	320	10	
Green River Land & Irrigation Co.	75,257	35	
Hammitt Canal	6,295	60	
Hanover Canal	10,682	50	
Hawk Springs Project	12,238	50	
Hubbard Canal	38,604	40	
James Lake Irrigation Co.	14,554	35	
La Prele Ditch & Reservoir Co.	18,558	50	
Lovell Irrigation Co.	11,320	25	
McDonald Canal	15,159	50	
Medicine Wheel Canal Co.	22,000		
North Laramie Canal Co.	4,133	50	
North Platte Canal & Colonization Co.	14,424	30	
Big Horn Basin Development Co.	204,650	50	
Paint Rock Canal	53,162	50	
Platte Valley Canal	18,171	30	
Rock Creek Irrigation Co.	11,696	45	
Sahara Ditch Co.	7,920	50	
Sidon Canal and extensions	20,559	30	
Tinsleep-Bonanza Canal	16,486	40	
Uinta County Irrigation Co.	26,000	35	
Wheatland Industrial Co.	33,115	45	
Wyoming Land and Irrigation Co.	4,526	50	

(a) Engineers' estimates where project is proposed or incomplete.
(j) Estimated at from $20 to $60 per acre.
(k) Estimated at from $50 to $60 per acre.
(l) Estimated at from $75 to $200 per acre.
(m) Estimated at from $100 to $250 per acre, including land.

TABLE III. COST OF U. S. RECLAMATION SERVICE PROJECTS

State	Project	Approximate acreage	Cost per acre From	To
Arizona-Cal.	Yuma	131,000	$55	$66
Idaho	Minidoka	118,700	22	30
Montana	Sun River	216,346	30	36
Montana-North Dakota.	Lower Yellowstone	60,116	45	..
Nebraska	North Platte	129,270	45	55
Nevada	Truckee-Carson	206,000	22	30
New Mexico	Carlsbad	20,277	32	45
Oregon	Umatilla	25,000	60	70
Oregon	Klamath	72,000	30	..
South Dakota	Belle Fourche	100,000	30	35
Washington	Okanogan	9,900	55	..
Washington	Sunnyside	102,824	52	..
Washington	Tieton	34,613	93	..
Wyoming	Shoshone	164,122	45	50

the cost of water rights on some of the U. S. Reclamation Service projects which have been so far completed that charges for water rights have been fixed.

The figures in the tables have been obtained from published reports of state engineers and other published data. It appears from Tables I and II that on some 90 modern irrigation works built by private enterprise the cost of water rights per acre averages about $53. It will be understood, of course, that this sum does not include the annual charge for operation and maintenance of the works.

On most of these private irrigation projects, settlers pay for their water rights in installments, the deferred payments bearing interest at a rate of at least 6% and often more. On the various irrigation projects built by the Federal government under the Reclamation Act, the average cost of the water right is a little over $41 per acre, or about $12 an acre less than on the recently built private works of a comparable size. The difference in cost to the settler is even larger than this, because while a settler on a Reclamation project also pays for his water right in annual installments, the deferred payments bear no interest.

It will be agreed without doubt by those who are familiar with the relative character of the engineering construction work on the government irrigation projects and on irrigation works built by private companies, that the government work is on the whole superior in permanence and thoroughness. In fact, one of the most common criticisms of the Reclamation Service has been that the engineers were spending more money in making the work substantial than the settlers could reasonably afford to pay.

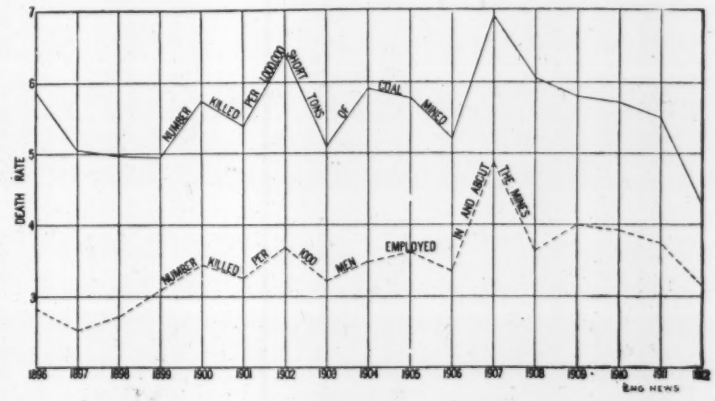
It will be appreciated, however, that to build substantial and permanent works makes the settlers' water rights so much the more secure and also reduces the annual charge for maintenance.

It is fair to add also that the investigations to determine the sufficiency of the water supply have generally been more thorough on the government irrigation works than on most private projects.

Of course these are the conditions which ought to obtain. The government engineers have had the advantage of plenty of money to work with and have not been hampered with insufficient capital as have many of the engineers employed by private companies. This consideration, with the fact that the capital advanced by the government bears no interest as does the money raised by bond issues for private irrigation works, gives sufficient reason why the work carried out by the government should be much more advantageous for the settlers than the work which the private companies have been able to do, as is shown by examination of the tables printed herewith.

The Decrease of Coal-Mine Accidents in the United States*

The coal-mining accidents of the United States for the year 1913 have been recently compiled by S. W. Horton, of the U. S. Bureau of Mines and a bulletin is being prepared showing statistics of accidents from 1896 to 1912. In 1912, 2360 men were killed in the coal mines of the country. With an output of 550,000,000 short tons, produced by 750,000 men, the number killed for each million tons of coal mined was 4.29, and the death rate per thousand employed was 3.15. The actual number of men killed was the smallest since 1906 and, as shown by the accompanying diagram, the rate per thousand employed was the lowest since 1899, while the deaths per million tons mined were the fewest yet.


DEATH RATE
NUMBER KILLED PER 1000 EMPLOYED MEN
NUMBER KILLED PER 1000 SHORT TONS OF COAL MINED
IN AND ABOUT THE MINES
ENG NEWS

DEATH RATES IN COAL MINING FOR YEARS 1896 TO 1912

It is claimed that while the exceptionally mild weather in the last few months of 1912 decreased the likelihood of disastrous coal-dust explosions, yet there has been a progressive improvement in mining safety. This improvement is attributed first to more efficient mine inspection of the various state mining departments throughout the country, in part to the greater care on the part of operators and miners and, in part, to the investigations and educational work of the U. S. Bureau of Mines.

*From information supplied by the U. S. Bureau of Mines, Washington, D. C.

⁂

Portable and Stationary Car-Dumping Machines have been developed in Germany for dumping end-door coal cars. In one design the machine is a small four-wheeled truck carrying curved girders (in a vertical plane), whose chord is at about 45° from the horizontal. The upper end is supported by a tower or bent on the truck. The lower end reaches within a few inches of the rails, having hinged rails to lie on the track and connect with the rails on the inclined girders. The track carries a hoist, with a cable passing over a sheave at the head of the girder frame. The machine stands just beyond a dumping pit or hopper beneath the track, and hauls the coal car up the incline, so that when the lower end door is removed the coal will flow into the pit. In another design, a double-truck flat car carries a turntable with pedestals supporting the trunnions of a tilting platform. Portable inclines extend from the car deck to the track. The platform is tilted to register with the incline and a coal car is hauled upon it. The platform is turned 90° and the car dumped endwise at the side of the track. The platform is then turned 90° more, and the empty coal car is run off at the opposite end of the flat car.

In the same plan as applied to permanent or fixed plants, a steel or masonry tower beyond the hopper supports the inclined track. A more important development has a long incline, the upper end being over hoppers, which are at such a height above the ground as to allow cars to be run beneath them. The coal car is hauled up the incline, which ends in a steep vertical curve on which the car stands while dumping into the hoppers. The coal cars handled by these machines are four-wheel cars of 10 to 12 tons capacity.

The City Waterway Bridge, Tacoma, Washington

The accompanying figures show two views of the new City Waterway Bridge at Tacoma, Wash., which has just been opened for traffic. The view on the left, Fig. 1, shows the west approach to the main structure and the closed drawbridge. The view to the right, Fig. 2, shows the drawbridge open, and the east approach truss. The bridge connects the business center of the city on the hill to the west, with the manufacturing center on the tidal flats at the east. It occupies the line of 11th St. and consists of a main deck with a 50-ft. clear roadway and two 10-ft. clear sidewalks, and a lower deck on the west side of the waterway, having a 19-ft. 4-in. roadway and one 10-ft. sidewalk, carrying 11th St. down to the water level.

The approach on the east side of the bridge consists of about 100 ft. of reinforced-concrete retaining wall, and about 575 ft. of steel-girder and column viaduct. The other approach consists of timber trestle, and the main bridge has two 190-ft. fixed truss spans and a 220-ft. vertical lift span, affording a clear waterway 200 ft. wide. The vertical clearance beneath the lift span at high tide is 60 ft. when the span is down, and 135 ft when the span is up. There being about 20 ft. of tide here, the clearance at low tide is 80 ft. with the span down, or 155 ft. with the span up. A 16-in. water main is carried from the ground, up the shore piers, and over the tops of the trusses of the fixed spans, then up the back of the towers and over the lift span on the light truss shown in the view. The bridge is paved with wood blocks and planks, and a double-track street railway is carried in the center of the roadway.

The piers are made up of the frustums of two cones connected by a reinforced-concrete web, the main solid portion of each cone being of mass concrete. They are carried in open coffer-dams to a footing of piles which have their heads about 35 ft. below low water and their points in some cases as deep as 115 ft. below low water.

The lift span is of the Waddell & Harrington type of design, each span consisting of a simple truss span suspended at its four corners by wire ropes which rise over cast-steel sheaves at the top of the towers and connect to concrete counterweights to balance the span. The operating machinery located in the house on the top chord of the suspended truss is actuated by motors connected to the street-railway circuit. Electrically driven gates operated from the motor house close each of the approach spans before the bridge can be raised.

During the construction of the new bridge, traffic was maintained across the waterway by building a trestle on the south side of the west half of the bridge, and the north side of the east half of the bridge, and connecting these two trestles by an old low-level swing span, which was part of an old bridge on the line of 11th St. The remainder of the bridge was taken down to allow for the construction of the new bridge. The trestle and old drawbridge were removed on completion of the high-level bridge.

The bridge was built by the City of Tacoma, under the direction of W. C. Raleigh, City Engineer, and Owen Wood, Commissioner of Public Works. The bridge was designed and its construction was supervised by Waddell & Harrington, Kansas City, Mo. The machinery and metal work for the superstructure were furnished by the American Bridge Co., and the International Contract Co., of Seattle, constructed the substructure and erected the superstructure.

FIG. 1. WEST PART OF BRIDGE, SHOWING DRAWBRIDGE CLOSED

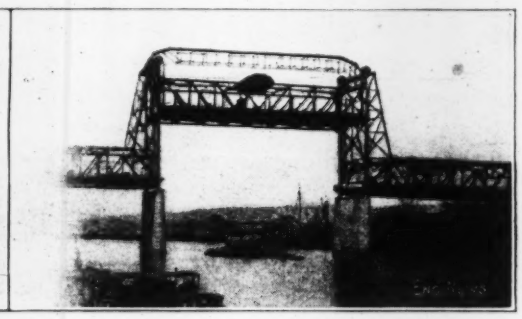


FIG. 2. EAST PART OF BRIDGE, SHOWING DRAWBRIDGE OPEN

FIGS. 1-2. THE CITY WATERWAY BRIDGE, TACOMA, WASH.

Street Accidents in London, England, cost the lives of 538 persons and injurieies to 16,651 more in the year 1912, according to statictics issued by the British Home Office. The greatest number of fatal accidents from any one class of street traffic was 182 deaths caused by motor omnibuses; electric cars caused 37 deaths; motor vehicles, 171; horse-drawn vehicles, 143, and horse-drawn omnibuses, 5. More than half the nonfatal accidents were due to motor omnibuses and other motor vehicles.

❖

Grade-crossing Abolition in New Jersey must be done hereafter at the sole expense of the railways concerned, according to an act passed by the legislature near the close of the session. In a protest to Governor Fielder urging that the bill be vetoed, President Samuel Rea, of the Pennsylvania R.R., said:

It is important that the public should understand that in the passage of this bill a grave injustice has been done the railroads.

In the last 20 years the Pennsylvania R.R. has removed 110 crossings in the State of New Jersey alone, at an expense to the company of about $8,000,000, of $73,000 per crossing. There are very few crossings of its railroad at grade in any of the cities. The company is now engaged in the work of track elevation through the city of Rahway, and eastward. There remain, however, some 1200 grade crossings on the Pennsylvania system in this state, the removal of which at $50,000 per crossing would cost $60,000,000, an expenditure which would neither produce additional revenue, nor decrease expenses.

The removal of grade crossings should unquestionably continue. The need is for some impartial tribunal, which shall have authority to arbitrate between the municipality and the railroad company and to bring them into coöperation if they cannot agree. Power should be vested in some administrative board, acting judicially, to take up, on the application either of a municipality or a railroad company, or on its own initiative, the case of any grade crossing, and after a hearing to direct the elimination of the crossing and the particular manner in which it shall be done and how the expense shall be proportioned.

Generally speaking, such is the arrangement in New York, Massachusetts, Vermont and Ohio. With so many crossings still to be eliminated, it seems unfair and unwise to propose that the railroad companies should be burdened with eliminating grade crossings, many of which have been opened subsequently to the construction of the railroads, and against either the entire cost, or an undue proportion of the cost, of their strong protests.

EDITORIALS

The Water-Filtration Question at Cleveland

The remarkably low typhoid death rate of Cleveland, Ohio, in 1912 (about 6 per 100,000) seems on its face to be wholly incompatible with the contention of the local board of health and certain members of the city council that the water-supply is so badly polluted as to make the immediate construction of a water-filtration plant imperative.

Some time ago a committtee of the Engineers' Club of Cleveland investigated filtration and made an adverse report which headed off a proposed bond-issue ordinance then before the city council. Early in 1912, D. D. Jackson, of New York City, made an exhaustive report on the Cleveland water-supply, with the conclusion that filtration would be chiefly of esthetic value, for the present, and that the wiser plan would be to carry out improvements which would continue still further the separation of the sewage discharges from the water intake. These improvements are now in progress or early prospect, and will result in lessening the volume and frequency of possible infection, both of which are held by Mr. Jackson and other competent persons to be relatively small. Meanwhile, it should be noted, the water-supply of Cleveland is being disinfected with hypochlorite.

Within the past few weeks the city council of Cleveland, or certain members of it, have tried to force the mayor, Newton D. Baker, into aquiescence with their advocacy of filtration. There has been much talk of an appeal to the State Board of Health for an investigation of the subject. In fact, the council did pass a resolution to that effect, but it appears that the resolution was not in such terms as would give the board authority to order filtration, since the resolution did not declare the water-supply to be a menace to health.

While we sympathize with every well considered effort to improve the quality of city water-supplies, we are not convinced by such of the arguments as have come to our attention that filtration at Cleveland is as vital to the health and as essential to the comfort and convenience of the people of that city as other objects of municipal expenditure. This, we understand, is the opinion of Mayor Baker, and we also understand that the officials in direct charge of the water-works are of the same opinion.

The question of water filtration at Cleveland or elsewhere should be settled on the basis of whether the expenditure of a given sum for this or other purposes will yield the greatest benefit to the largest number of people. The city authorities have taken competent expert advice as to the need for filtration and they have also had the public-spirited advice of leading engineer-citizens. True, the board of health is strong for filtration, but its viewpoint (we may unwittingly do it injustice) seems to be the narrow medical one of advocating a counsel of perfection, with no careful weighing of the benefits to health which will ensue and with little or no regard for cost or for the other health and general welfare needs of the city.

Presumably Cleveland, like all other cities dependent upon surface water-supplies, will yet have a filtration plant. The question for it and other cities to consider is whether, in view of financial and other local considerations, filtration or something else should take precedence at a given moment. The evidence before us points to a delay in filtration at Cleveland.

⁂

The Responsibility of Engineering Societies to Their Members

An eminent scientist, resident in New York City, was employed by the Federal Government to perform certain expert scientific work. A Congressional Committee, in presenting a report of a recent investigation, made serious charges against this scientist. The report was given out to the press and was widely published.

The New York Zoological Society, of which the scientist referred to was a prominent member, took up the matter for investigation. The Executive Committee of the society found that the report of the Congressional Committeee referred to had been prepared by the chairman alone and had never been submitted to the whole committee for its adoption. Further examination of the testimony taken before the committee showed there was nothing whatever in it which cast any reflection on the honesty or honor of the scientist referred to. The Executive Committee therefore adopted resolutions reciting the result of its investigation and declaring that the scientist should be exonerated from all blame, and that the attack upon him was unjustifiable, malicious and untruthful.

It is, unfortunately, true that the injury done to a man's reputation when it is attacked by Government officials, either executive or legislative, cannot be wholly cured when a man's professional associates exonerate him from all blame. The newspapers give wide publicity to scandal; but small space to a man's defence of his reputation.

This is not a sound reason, however, why a professional society should refrain from doing what it can to protect its members when they are unjustly accused. Any engineer who has been in a position where he felt that every man's hand was against him, through no fault of his own, can appreciate how welcome at such a time is the knowledge that his own professional friends and associates have not lost faith in him and in his honesty.

It may be objected also that if an engineering society were to undertake to investigate in a judicial manner every case in which unjust accusations are brought against any of its members, its task would be a very large one. Good judgment would dictate, of course, that such investigations should be confined to the special cases where the prominence of the accused, or the impossibility

of resort to the ordinary methods of defending one's character make the case one meriting action by the society.

Care must be taken, of course, that a professional society shall not undertake the defense of its members when they are justly deserving of censure. The best rule to adopt would probably be to imitate the organizations in other professions. The cases are not at all infrequent where a local medical association, or clerical association, or bar association will take formal action for the investigation of some case where a prominent member of the organizations named has had his reputation assailed and will, after judicial investigation, bring the influence of the whole organization to the defense of the accused party.

We see no reason why organizations of engineers should not be equally ready to come to the refense of their members. It is, of course, evident that when an engineering society undertakes to defend the reputation of an engineer unjustly attacked, it is really defending the reputation of the profession as a whole.

⁂

Where Should the Money for Good Roads Construction Be Spent?

A recent headline in the automobile department of a metropolitan newspaper raises a very pertinent question as to the location of good roads. The headline reads as follows:

"Roads that Go Somewhere Is the Cry—Various Plans for National Highways—One Would Connect All State Capitals."

Even a cursory examination of the literature which is being widely circulated to further the building of good roads shows clearly that what the manufacturers and owners of pleasure automobiles chiefly desire are roads from city to city for the use of automobile tourists. It is not to be denied that these people constitute a large and very influential portion of the population, and that they pay by reason of their wealth an amount of taxes far greater than their importance numerically.

On the other hand, it is a very serious question how far the States are justified in expending money raised by general taxation in the construction of highways to be used chiefly for pleasure purposes by a comparatively small proportion of the taxpayers, especially when the money is to be raised by placing a mortgage on future generations, as happens when good roads are built by bond issues.

The stock argument in favor of good roads has long been that it would enable the farmer to haul his produce to market more cheaply. If this is reason for the construction of good roads, the money should not be spent in connecting city with city, but in building roads radiating from each city out to the country districts surrounding it. Up to the time when automobiles became numerous, a half-dozen years ago, such radial roads were in fact the only highways which carried a considerable traffic. Traffic over roads connecting one city with another was actually less in volume than it used to be a half century ago before railways, steam and electric, became supreme in the carriage of both freight and passenger traffic.

Massachusetts and New Jersey, which were the pioneers in State road construction, both confined their efforts in the earlier years of their work to the construction of radial roads. Notwithstanding the advent of the pleasure automobile and of the freight truck, we believe that this should still be the primary aim in the distribution of state appropriations for road construction. After such radial roads are completed, it will often be possible, especially in the thickly settled states of the East, by comparatively moderate expenditure to fill in short gaps so as to create the through roads which the automobilists naturally desire.

It is entirely clear, however, that the automobilists are not willing to take second place. They are concentrating their agitation, as stated above, on the construction of through roads. In doing this, however, they are incurring inevitably the opposition of the farmers and of the business men in the smaller cities as well. In more than one state legislature, the battle over road appropriations is turning upon the question whether the money is to be spent for the benefit of the public as a whole or for the automobile tourists.

It is not without interest in this connection to call attention to the fact that the through roads which the auomobilist desires will have a much higher rate of wear and will require larger sums for maintenance than the local roads which the general public desires. It is on these through, city-to-city roads that the motor-car tourist runs his car at 30 to 40 miles an hour, and high-powered automobile freight trucks go tearing along at a speed which is ruinous to the road which the taxpayers have to maintain. It seems to us, therefore, that the influence of the engineering profession should be exerted on the side of the local roads.

⁂

Control of Railway Operation by Organized Labor

As was predicted at the time, the demand made last year by the engineers and firemen employed by the railways e ast of Chicago for an increased rate of wages has now been followed by similar demands made by the conductors and trainmen. The railway companies have refused these demands but in view of the previous success of the engineers and firemen, there seems no room for doubt that the conductors and trainmen will demand arbitration under the Erdman Act as the alternative of a general strike.

In the event of a general strike covering all the railways of the country, or any large part of the country, it would be a practical impossibzility for the railways to obtain men competent to take the place of the striking workmen. This will be agreed to by all who realize the complicated and intricate character of modern railway operating conditions. It is an absolute necessity both for reasonable safety in train movement and to avoid congestion of traffic to have employees who are reasonably familiar with their duties.

In order to make the position of the railway labor unions absolutely impregnable, however, and to prevent the possibility of a railway replacing its striking workmen, even in the case of a strike on a single railway, a bill has been introduced and is being actively urged before the Pennsylvania legislature which would prevent any railway company in Pensylvania employing any conductor or engineman unless he has had 18 months pre-

vious experience in railway service. This experience must have been either as a brakeman or a switchman in the case of candidates for a conductorship, or as a fireman or engineman in the case of candidates for appointments as engine runners. The enactment of such a law would amount to insurance by the state that any strike of railway employees would be successful.

Such pending state legislation, together with the possible adoption of a federal law under which labor organizations will be exempt from prosecution under the Sherman law against monopolizing trade and commerce, furnish new reasons why Congress, in the interest of the public, should undertake at the present session the legislation which has been asked for by both railway officers and railway employees for better adjustment of their relations and the prevention of strikes.

LETTERS TO THE EDITOR

Unbalanced Bidding.

Sir—The article on Unbalanced Bidding, p. 777 of your issue of Apr. 17, seems to show that both parties to the controversy are wrong, inasmuch as each tries to bring the other to a false basis on which to canvass bids.

The trouble originates in the vicious regulation, practically making it a misdemeanor on the part of the engineer if the final quantity of any item exceeds the upset quantity given in the specification. My practice for many years has been to make the quantities of uncertain items in the bidding schedule 10% or so smaller than the actual estimated quantities, the reduction being as nearly symmetrical as possible. It has been my invariable experience that contractors are satisfied if the final measurement exceeds that on which they made their bid. On the other hand, if said measurement is much less, they invariably feel disappointed and frequently demand a remeasurement.

Occasionally, superior officers have criticized me for following this practice, but I prefer to deal with them rather than to pacify disappointed contractors. If it is possible to give the exact quantity of anything, as length of pipe or number of valves, as noted in the article, such quantities should, in all honesty, be given. Specifying two valves when it is known that but one is required, is certainly deception. It is manifestly impossible to give exactly correct quantities of most items of a contract. They must necessarily over- or underrun. Then why is it not as fair to make them small as to make them large if the former tends to harmony in settling with contractors? Unbalanced bidding schedules are certainly as vicious and indefensible as unbalanced bids. Both are sure to lead to trouble. The only excuse that can be offered for padding the bidding schedule is to insure that the final cost will not exceed the aggregate as shown by the bid. There are two reasons why this excuse should have no weight:

(1) This aggregate is not the engineer's estimate. It is entirely vicious for authorities to delay ordering the execution of work until bids are received, because for anything except the most unusual work, engineers can estimate the unit prices nearly enough so that the authorities can decide whether or not they wish to invest the capital involved. If such estimate is between the final cost based on the higgest and lowest bids received, it is certainly close enough and in fact much nearer the final cost than an unbalanced schedule multiplied by an unbalanced bid. Corporation lawyers have no right to consider the aggregate of the bidding schedule an estimate of the cost of the work.

(2) An engineer should not manipulate the work to make its cost match the estimate. I once knew a builder of odd lots of machinery who told me that he made a practice of never adding up his cost till the work was done for fear that he would be tempted to skimp if a loss was in sight. This is the true spirit. Do the work right whatever happens. The pride of matching one's estimate is mere vanity.

In localities where the drastic regulations of the New York charter and the corporation counsel do not prevail, there is generally no trouble between engineers and contractors if both intend to be fair. It is probable that the era of price competition between contractors is passing, as it has passed between transportation competitors. What will follow is uncertain. Reforms follow when conditions become unbearable. It would seem that this point is nearly reached when known quantities are doubled in the bidding schedule and 1c. per cu.yd. is bid for rock excavation in trench.

J. P. Snow.

Boston, Apr. 21, 1913.

Sir—I have read with interest the article in your issue of Apr. 17 entitled "A Plan to Eliminate Unbalanced Bidding on City Contract Work." This is a subject of great interest and importance. It is surprising that it has not already received more thorough discussion. By way of stimulating the present discussion, permit me to suggest another means of accomplishing the same end.

When it becomes necessary to let a contract for a piece of engineering work at public letting, let the engineer write into the contract the unit prices used in his preliminary estimate. Let these prices be sufficiently liberal to insure a good profit on the work, a profit that will compare favorably with the profits derived from other lines of business. Then let the bidder be required to state in his proposal the largest actual payment which he is willing to make to the party doing the work for the privilege of entering into the contract containing the unit prices from the engineer's estimate.

It will be an easy matter to recite offhand numerous reasons why this method would not be successful. The one which occurs first is that a considerable investment

might be required at the beginning of the work and that the funds for such an investment are not generally available. It is doubtful whether this objection is sound.

On the other hand it would effectually eliminate unbalanced bids, it would not require the bidder to disclose his knowledge of the cost of work, it would do much to eliminate irresponsible bidders and when the contract is finally executed the returns from the contractor's operations would at all times be sufficient to cover the cost of the work and leave a margin of profit sufficient to induce its completion by other parties if at any time the contractor should lose heart.

ALBERT J. HIMES.

Cleveland, Ohio, Apr. 24, 1913.

French and German Literature for Electrical Engineers

Sir—I have read with great pleasure Mr. Herschel's article, "The Study of Modern Languages in Technical Schools," in your issue of February 27. In expressing my appreciation therefore, I trust you will permit me to add a few remarks on this subject with especial reference to electrical engineering.

Mr. Herschel attacks a vital defect in American technical education when he writes that "the accumulation of facts is not the most important thing." Nevertheless, it continues to be regarded so in most of our universities, and graduates are turned out with plenty of facts but with very poor grounding in fundamental principles. Hence, the young graduate, while usually very fluent in the time-worn and classical, but often hopelessly out-of-date class-room problems, is lost when he gets off the beaten track.

This point is somewhat related to the question of the value of modern languages, since we find that German and French mathematical and technical literature is taken up more with the exposition of principles, whereas, the American and British is more on the order of accumulation of facts and solutions of particular problems.

With reference to the relative values of German and French for electrical work, there is little doubt that German is, on the whole, superior.

Some of the reasons for the general superiority of German over American technical literature are not far to seek. First, in Germany we find a very large number of research workers and advanced students who both create and demand a large supply of literature of high order, and this, in turn, has developed large and magnificent publishing interests. Second, for the most part the aim of German writers is to produce something readable, that is not a mere setting down of facts, but a connected account or expansion of a subject, presented in such manner as to require the least amount of time and mental effort on the part of the reader.

The vast amount of German technical literature and the field of operations covered by some of the large publishers is surprising to one acquainted with only American and British literature. Consider the enormous number of high-grade books on mathematics, mathematical physics and technical subjects published by B. G. Teubner, and those on engineering subjects published by Julius Springer. The list offered by the former, both as regards number and quality, can scarcely be approached by any other publisher in the world, and when we find in this list a half dozen or so books printed in English and written by American mathematicians, we gain some idea of the enterprise of this publishing firm and the extent of its operations. One of these writers once explained to me that the American publishers were not so liberal and, what was more important, that a work published (even in English) in Germany by B. G. Teubner was assured of a much larger circulation than if published in America. Whether the language used be German, French or English (and indeed Italian) makes comparatively little difference to the European mathematician but it must be in English to have any sort of circulation in English-speaking countries.

When the American student has acquired a good reading knowledge of German, there is at once open to him a store of literature that would, otherwise, be closed. For the percentage of literature that is translated is small and much of the best is never translated at all. Moreover, translations are usually late in appearing and quite frequently the original excellence is lost.

A good example of a German electrical work, is "Die Wechselstrom technik" by Arnold and LaCour. This work is devoted exclusively to alternating currents and consists of six volumes containing in all about 4000 pages. While encyclopedic in dimensions, it is most carefully written and Arnold was not only well known as a writer but also as an investigator and inventor. (The Wagner single-phase motor, made in St. Louis, was originally manufactured under a patent issued to Arnold and has enjoyed a large and successful use in America.) The foremost American work on alternating currents is undoubtedly Steinmetz's two books, "Alternating Current Phenomena" and "Transient Electric Phenomena and Oscillations," containing together, a little less than 1400 pages. The best British work on this subject is probably Russell's "Alternating Currents" in two volumes with a total of less than 900 pages—about as much as the one volume of Arnold devoted to synchronous machinery.

I do not wish to be understood as detracting in the least from the value and worth of the two mentioned works in English, for their quality is quite as high as anything in any language and Steinmetz's "Alternating Current Phenomena" is considered a classic not only in this country but in many others. But the comparison illustrates quite nicely the fact that German scientific literature is considerably more extensive than American and British. Furthermore, our foremost writer on electrical subjects is of German birth and education—a writer whose numerous and excellent contributions have given American electrical literature a place immeasurably higher than it would have without them. I refer to Dr. Steinmetz.

Perhaps German is of more value to the electrical than the civil engineer, but let those who would deprecate too much the value of French and German remember that much of the value to be got from European scientific and engineering activity can only be obtained through a knowledge of these languages.

R. C. POWELL.

Superintendent of Electric Distribution, Oakland District, Pacific Gas & Electric Co., 518 Thirteenth St., Oakland, Calif., Apr. 15, 1913.

Sir—I have read with much interest the article by Prof. W. H. Herschel on "The Study of Modern Lan-

guages in the Technical Schools," and your editorial on the same subject, in the issue of Feb. 27.

The average teacher of languages makes his subject much more uninteresting to the student than is at all necessary. He lumbers up the study with a long list of rules of grammar, which few can understand and scarcely anybody remember, giving to each one a very imposing list of exceptions which are still more difficult to remember, and pays little attention to the vocabulary. The reading lessons are used largely as illustrations of the rules of grammar and consist mostly of extracts from classical authors, which are none too easy to understand, even after proper translation into English.

A reading knowledge of French technical literature can readily be acquired. The language used by French technical writers is generally very clear and simple. The construction of the French language differs but little from that of the English and nearly all the scientific and higher technical terms closely resemble in form the corresponding ones in English, although there is sometimes a shade of difference in the meaning. Technical dictionaries are sometimes useful but it is better for the specialist to start with elementary treatises in his line, in which the technical terms are defined. This, of course, is true of any foreign language.

So far as the rules of grammar are concerned, a reading knowledge of the German language also can be acquired without much difficulty, if the rubbish can be eliminated. The vocabulary is, however, more difficult to acquire than the French. Aside from the chemical terms, nearly all the words are derived from German roots, and the scientific and technical terms do not, as a rule, resemble those of corresponding meaning in English. Many common words have more than one meaning and this is perhaps the most serious difficulty the student has to contend with. The key to the language is a thorough understanding of the rules relating to derivatives, a subject which is strangely neglected by many teachers. The German writers are much inferior to the French in clearness and s' nplicity and some of them appear to take pride in the fact.

A knowledge of a foreign language is much more useful to some engineers than to others, but no young man can say in advance, even approximately, what his career is to be. I think that a man can hardly be considered well educated unless he has a good reading knowledge of either French or German or, better still, of both. It will almost certainly be useful to him at some period of his career. If he does not acquire it in his youth, it is doubtful if he ever does. It takes patience and hard work, but it pays. As in many other cases the difficulties diminish greatly, if resolutely faced.

As to the comparative value of calculus and German, most of the better classes of French and German technical books and periodicals are written for university graduates, use calculus freely and occasionally indulge in determinants, projective geometry and other branches of higher mathematics, besides chemistry, geology, etc.

Regarding the value of foreign technical literature; the further an engineer advances in his profession, the more his ingenuity and resourcefulness come into play and the more insistent becomes his search for ideas and information of many kinds from every possible quarter. The French engineers are brilliant, ingenious and artistic; therefore their works are worth studying. The Germans are patient, painstaking and wonderfully industrious and have a genius for profound investigation, which has produced epoch-making results. Their most exhaustive researches are seldom translated in full. They also produce many treatises on scientific and technical subjects, which are encyclopedic in character and contain many records of work which has been done in that line and which are extremely valuable sources of information for the engineer. None of these has been translated, so far as I know.

As to the best time to study this subject, the earlier the better. There are schools in New York City, in which children of newly arrived foreigners are taught English to prepare them for attendance at the public schools. A three months' course prepares them nicely. I see no reason why a high-school student could not learn to read understandingly in one year, if properly taught, ordinary literature in a foreign language. After such a course, a moderate amount of practice in college, to dissipate his dread of the undertaking, should start him on his way.

I know little of technical literature in either Spanish or Italian, but judging from the references in current literature, there seems very little of any value in Spanish, while the Italians are forging ahead a great deal in mathematics and are doing some excellent engineering work. They are, moreover, almost as artistic as the French. The Norwegians and the Swedes are doing excellent work, the records of which often get into print either in French or German. They are fully as able, man for man, as the Germans but are fewer in numbers. The Russians do some good work, which becomes known to the outside world through the enterprise of the Germans. The same may be said of the Hungarians, etc., in Austria. It is thus seen that the German language is the key to a much larger store of knowledge than the French, yet the latter language is so easily learned, that it is well worth while studying.

Looking into the future, the indications seem to be that, as a liberal education becomes more accessible a greater number will be able to read French and German, rendering it less necessary to translate the more advanced works into English. Hence the progressive engineers of the future, many of whom are now in college, will find it more useful to acquire a knowledge of those languages, than do those of the present generation.

WILLIS WHITED.
Engineer of Bridges.
State Highway Department, Harrisburg, Penn.
Mar. 31, 1913.

City Topographic Surveys

Sir—Your issue of Apr. 3 contains a valuable article on the Topographical Survey of Cincinnati, Ohio, and the reasons for deciding on certain methods of work and limits of error are clearly set forth.

It seems to the writer, however, that a scale of 400 ft. to the inch is rather small for the intended purpose, and that 200 ft. to the inch would be more suitable for designing and laying out drainage areas and sewer and street lines.

The use of a planetable for the field work is surprising, unless there was little detail to be shown. The

transit and stadia method, with no notes recorded in a book and plotted in the field as taken, gives all the advantages claimed for the planetable in avoiding blunders in plotting. That the former method is more rapid was proved by the writer on the Baltimore Topographic Survey and, including an extra man as plotter, it was as cheap, with the added advantage of a full set of notes ready for use in case the field map was destroyed and the possibility of calculating the stadia traverse closures instead of only scaling them.

The closing remarks as to the comparative cost of the Cincinnati survey and the Baltimore and Washington surveys may simply indicate that less work is given for less money. Gillette's "Cost Data" gives the cost of a number of such surveys, and the topographic work of two of those mentioned was under the direction of the same engineer, viz., St. Louis and Baltimore. But the amount of detail and the accuracy of the two differed considerably. The average number of shots per acre over 33 square miles of Baltimore was 10 and one ¼ square mile contained 840 houses requiring 21.7 shots per acre. Furthermore, the work in Cincinnati is being done by contractors who may work even more than the 9 hours per day worked in Baltimore.

R. A. MacGregor.

Assistant Engineer, Bureau of Highways, Manhattan, New York City.

New York City, Apr. 9, 1913.

[According to our usual custom we submitted proof of the letter above to Mr. Mitchell and have received the following reply.—Ed.]

Sir—There is no more vexed question in surveys for mapping purposes than that of scale. When that question has been satisfactorily settled, other questions such as methods and instruments are easily taken care of. But the scale itself depends largely on two things—the purpose of the map and the money available for its production.

In the uses being made of such sheets of the Topographic Survey of Cincinnati as have so far been produced it is clear that in that part of the preliminary work which comprises the laying out of drainage areas, the adopted scale (1 in. = 400 ft.) leaves little to be desired.

This must be understandable when one remembers that runoff coefficients are not exact quantities; neither are the adopted values for maximum storms. The uncertainty in either of these quantities is usually such as would almost immediately consume any added accuracy in the topography of the drainage areas secured by using larger-scale maps.

In the designing of the sewer lines the larger-scale map, if produced with a corresponding increase of accuracy, would undoubtedly facilitate the work. Whether this increase in facility and the natural increase in accuracy resulting from the use of the larger-scale map are such as to justify its added cost may well be questioned.

As regards the use of the planetable: the planetable method admits of any desired degree of accuracy and of any amount of detail. In the planetable work, notes are kept of all shots, and an error in closing a planetable traverse may at once be searched for, and if it be in either the computation or the distance-plotting it can be checked.

The notes, however, record no direction and are, therefore, valueless as insurance. (Is insurance needed?) On the other hand two readings of a horizontal circle are eliminated by the use of the alidade—and the chances of error thereby reduced.

Concerning cost it must be admitted that the absence of cadastral features from the Cincinnati map removes an element, the size of which it would be difficult to even estimate.

Hugh C. Mitchell,

Engineer in Charge of Topographic Survey.

Cincinnati, Apr. 29, 1913.

Panoramic Camera and Planetable vs. Stereophotography for Mapping Alaskan Topography

Sir—Mr. Lemberger's article in your issue of Mar. 27, has brought to our attention many possible applications of stereophotography. The method should be particularly interesting to topographers of this country. The instruments of Pulfrich and von Orel seem to reduce the office work of contour plotting to a point below which it is not likely soon to be carried.

Passing the various other types of surveys in which the method might be employed to advantage, I wish to consider it as a means for making a general service topographic map on a scale of a mile to the inch or smaller.

The prospective field which is most likely to furnish an immediate subject for a test, lies in the more rugged sections of the West and Alaska. Regions of great relief afford the most suitable types of topography for photographic surveying and are consequently the sections where the camera is quite certain to be employed first.

The area should be comparatively large, such as might be covered by a map in the conventional quadrangular form. A requirement of any photographic method is that the photographs be adequate to supply contours for all of the country within the map limits.

Probably the most serious handicap to the stereophotographic method is the necessity of obtaining the base. The most advantageous positions from which data for a topographic map can be obtained are naturally the commanding peaks. Many of these afford scant room for a single tripod, few would probably be broad enough in one direction to permit the laying out of a base 300 or 400 ft. long; while the mountains which would furnish room for four or five bases, combined with good positions for a set of panoramic views, would be rare. Difficulty, annoyance and loss of time would attend the selection of stations.

In the making of a map of the kind under consideration I do not believe the stereophotographs would greatly lessen the number of instrument stations, for the reason that transverse ridges cut off the vision to so great an extent that about as many positions would have to be occupied in the use of one method as another. The far side of the ridge must be seen that it may be properly represented on the map. To accomplish this the camera must be taken to many elevated points, the number of which would not differ materially in either case.

That objects can be more readily and rapidly identified on stereophotographs than on those taken from widely separated positions is a very great advantage. It is probably the greatest improvement in photographs so

taken. On the other hand it is not difficult to identify points in moderately good photographs of the most colorless of landscapes.

The office work would be very greatly lessened by the ingenious stereoautograph of Capt. von Orel. The office work, however, for Alaska maps seldom exceeds one-fifth the cost of the field-work; hence the expense of the map could not be very greatly reduced by its use. In cases of urgent need of the map the instrument would be of much greater value. Much honor is due the inventor for devising an instrument which so reduces the effort and tediousness of routine office work.

A brief comparison is attempted between the stereophotographic method and one in which a panoramic camera supplements the planetable. It is assumed that the results of either are of an accuracy comparable to that obtained by the common planetable method.

The timing of the exposures is undoubtedly the detail of all photographic methods which requires most attention. Films for duplicate views, when the proper exposure is uncertain, can be provided with much less additional weight than extra plates.

Three men will be required to pack to the stations and operate the stereophotographic instruments: two can handle the planetable and panoramic camera with ease. Three exposures, requiring 15 minutes, with the panoramic camera complete the horizon. To embrace the same field at least 14 exposures must be taken for stereoscopic use.

The panoramic camera can be operated in any place where the planetable can be used. A dozen sights with vertical angles, the photographs having been taken, complete the operations necessary at the average station. The total amount of time for the work at a station need seldom be more than one hour, and is often less than half that time.

For the seven pairs of photographs and the laying out of the bases from two to three hours at each station would be necessary. If considerable difficulty were encountered in the selection of ground for the bases, the time might be increased to the point where little would be gained over the regular planetable method.

In a region of heavy fogs and mist the advantage of an instrument, which, if necessary, will enable the topographer to complete his work at a station in 15 minutes, has a value that can scarcely be calculated in comparison with others that might fail in so brief a time.

The film cartridge packed in a waterproof case, which is sufficient for a complete panorama, weighs 4 oz.. The equivalent in 5x7-in. plates (14) weighs 42 oz. Heavier materials require additional means of transportation. For a field season of three months three extra horses would be necessary to pack the plates. For work in remote regions one man and three horses would add about one-fifth to the cost of field-work.

Using the stereoautograph the examples mentioned in Mr. Lemberger's article indicate that the office work will take as much time as the field-work. With the panoramic method the time for office work is about double that for the field-work. The resulting ratio of costs is about as 11 to 12, in favor of the latter method. The first cost of instruments is not here taken into account. The cost of all instruments, field and office, for the panoramic method is approximately equal to the cost of the phototheodolite alone.

Emphasis should be put upon the gain to topographic surveying by the combination of the planetable and camera. In the use of the planetable for secondary control, the skeleton outline developed aids to a large degree in keeping before the topographer the progress made from day to day and gives him a diagram by which he can best follow the successive stages of the map which are chiefly recorded in the photographic negatives.

J. W. BAGLEY,
Topographic Engineer, U. S. Geological Survey.
Washington, D. C.
Apr. 14, 1913.

Shop and Mill Inspection of Structural Steel

Sir—Your editorial on "Engineering Work Which Pays" in ENGINEERING NEWS of Mar. 20, points to "the tendency toward the concentration of engineering work in the hands of large organizations." Concentration in fabrication and construction work has proved both efficient and economic. But as to the work of designing-engineers, such a tendency may bring very different results. It is not easy to see how it can be justified, either economically or professionally.

With $10,000,000 worth of bridges a year to design and supervise, it is certain that practically all of the engineering work must be left to salaried assistants, with comparatively little supervision from the "head of the concern." One concern in this class offers $40 per month to assistants one or two years after graduation from high-class engineering schools. Moreover, the "head" of such a concern is liable to become so engrossed in the commercial aspects of the business as to lose what efficiency he may once have had as a designer. This has been known to happen.

The economic gain from concentrating in one office the design and supervision of bridge work to a value in excess of $1,000,000 a year is not much, except it be at the expense of the quality or grade of work turned out. This statement takes account of all possibilities in standardization for the average run of work.

On the other hand, there is one branch of bridge work where concentration would make extraordinary improvements possible, but in which no very decided tendency that way is noticeable. That branch is the shop and mill inspection of structural steel. Perhaps the fact that some of the larger bureaus seem inclined to divide all of the economies made possible by large tonnage between reduction of price and increase of profits, instead of using a fair proportion of the savings to improve the grade of inspection, has operated to retard concentration in this line. As the cost of inspection, according to existing standards, is not much more for 20,000 tons than for 2000 tons, when all at one shop or mill, it is not difficult to figure how the bureaus make a profit at prices one-third the rate per ton they asked a few years back.

If the present tendency were more in the direction of improving the work of inspection instead of cutting prices in competitive bidding, there would be more hope of raising the standard without a radical change in the organization of the inspection business. So called inspection can be done at almost any price, but the purchaser rarely gets more than he pays for, and few have

any idea what first-class inspection is or what it is worth.

If the standard of inspection cannot be materially raised under the present competitive bureau system, there remain two alternatives, either one of which, it is fair to hope, could show better results: (1) A trust of inspection bureaus with a far-sighted and broad management; and (2) a coöperative inspection association formed by the larger purchasers of structural steel.

The minority report of the Committee on Iron and Steel Structures of the American Railway Engineering Association, briefly referred to in ENGINEERING NEWS of Mar. 27, was written to call attention to the very great advantages that could be realized by concentrating shop and mill inspection in one large organization, but your report of those proceedings seems to miss the point entirely. While this minority report was not discussed at the convention, there is evidence that it made a gratifying impression under the surface.

ALBERT W. BUEL.

15 William St., New York, Mar. 29, 1913.

[We realized the point and purpose of Mr. Buel's minority report, noted in the last paragraph of his letter, but as it was impracticable to do more than mention it in a review of the score of matters presented at the convention it was our intention to publish an abstract of it separately. We give such an abstract below, and the majority and minority reports of the Committee on Iron and Steel Structures are given in full in *Bulletin* 152 (December, 1912) of the American Railway Engineering Association (900 So. Michigan Ave., Chicago).—ED.]

The writer has suggested that an effort be made to outline some method or system which would promise improvement over existing mill and shop inspection. Also that a cooperative railroad bureau, combining the good features of "company inspection" with those of "bureau inspection," deserves consideration, particularly on account of the very great advantages which the consolidation of a great tonnage would give, permitting the subdivision and specialization of work to a high degree under competent and experienced resident or district engineers and managers.

On every hand complaint is heard that bureau inspection is unsatisfactory. For over 26 years the writer has had an intimate acquaintance with bureau inspection, both from the inside and outside, and in several respects the conditions are less favorable for good work now than formerly. At one time a considerable number of inspectors were men with some engineering training, but it is now rather exceptional to find an inspector who has had any such education or experience. Many are men who have worked in bridge shops in the "laying out" and similar departments, while formerly men with some experience in the drafting and computing departments found inspection jobs attractive.

In former years, when the bureaus were much smaller concerns, the inspectors frequently came in contact with the principals. Now the time of the head men is so taken up with soliciting business, office routine and correspondence, that they rarely see inspectors, hardly ever to give detailed or technical instruction.

The founders of the best bureaus were competent and experienced bridge engineers, who took a professional interest in their inspection work, and had been inspectors. Now, with two or three notable exceptions, one looks almost in vain for the name of a bridge engineer in the bureau organizations. Owing to division of territory and exchange of work, sometimes a job taken by one bureau will be executed by an inferior one. Within the past five years the writer had occasion to do personally a considerable amount of shop inspection, and was impressed with the change in conditions and shop practice that had occurred within a comparatively few years.

Company inspection is sometimes better, but often worse, than bureau inspection, and even all the work for a system of allied lines does not consolidate sufficient tonnage to permit such an organization with division of work and specialization as the writer has in mind.

As to mill inspection, all who know the conditions agree that it is largely a farce. The test reports are only of value for file, to bring out if anything ever happens, or as exhibits in court. While more difficult to improve than shop inspection, consolidation of a great tonnage, as suggested, would permit of a very material betterment in the quality of mill inspection at little more than current costs.

On the other hand, the shop and mill practice and standards have been so greatly improved since [shop and mill] inspection by or for the purchaser became customary that there is nowhere near as great need for rigid inspection *in* each individual case. But unless the average inspection is kept up to a high standard there is danger of lowering the standard of quality for structural-steel work and material. Not only that, but an incentive to further improvement will be lost. The ideas suggested with the purpose of improving shop and mill inspection may be expressed as follows:

(1.) The shop and mill inspection of structural steel, to be efficient and satisfactory, should be done on a scale large enough to economically permit the employment at each shop or mill of a corps of men, who may be called checkers. Each one of these is specially fitted and trained for a certain part or detail of the work under a resident inspecting engineer, thoroughly familiar with all details of structural steel and its fabrication, competent to direct the corps of checkers and decide questions calling for the judgment of a man of experience and structural engineering training. Resident inspecting engineers should report to the district chief inspector or manager, who should be an expert in structural steel and its fabrication, as well as a competent bridge engineer, and he in turn should report to the executive head of what may be called the American Railway Inspection Association. On technical matters and with proper regulations, however, he may report to and receive instructions from the chief engineers and bridge engineers of the railway companies which are members of the association.

(2.) The American Railway Engineering Association should use its influence to induce the railway companies to delegate officials to meet and discuss ways and means and (if it appears practicable) to provide for establishing the American Railway Inspection Association as an organization to make a highly improved and standardized shop and mill inspection of structural steel, furnishing the same at cost to the railway companies which are members of or supporting such association. As this can hardly become effective without the support of railway companies representing about 75% of the annual railway purchases of structural steel, it would seem desirable to have the official delegates empowered, under proper restrictions, to pledge the adherence of their respective companies to the support of the project.

Later on, such an organization could be expanded to include the inspection of steel rails, but as this would require practically a separate corps—only the district chief and his office and probably a chemist, being common to the inspection of both structural and rail steel—it will no doubt be considered advisable to defer this question to a future time. However, as general officers and chief engineers are greatly interested in all matters respecting rails, it might aid in securing their coöperation to suggest the future possibility of the proposed American Railway Inspection Association taking up and standardizing rail inspection. The present status of rail inspection problems suggests that the time is hardly ripe to press this matter, but it would do no harm to refer to it as a future line.

The size of each shop corps should be about one man for each 10,000 tons annual capacity of the shop. The number of independent inspectors at present employed is probably equal to or greater than that. This would require that the inspection of about 50% of the shop capacity be done by the proposed organization. Otherwise the cost of inspection would be greatly increased, and my object is to try to show that a very superior inspection method can be devised without greatly increasing the cost.

The district chief, or manager ought to be a man worth at least $200 to $300 per month, depending on the importance of the district, and could cover a radius of, say, 100 miles from Pittsburgh, Chicago, Philadelphia or Cleveland. Each resident inspecting engineer should be worth not less than $200 or $250 per month at the larger shops, down to a minimum of, say, $150 at the smaller shops. The wages of the other men in a shop corps would range from about $1 per day for the scale boy to $4 per day for the men checking field fits, templets and laying out. This will work out to between 40 and 50c. per ton for shop inspection in average shops down to 30c. per ton in the largest shops.

❖

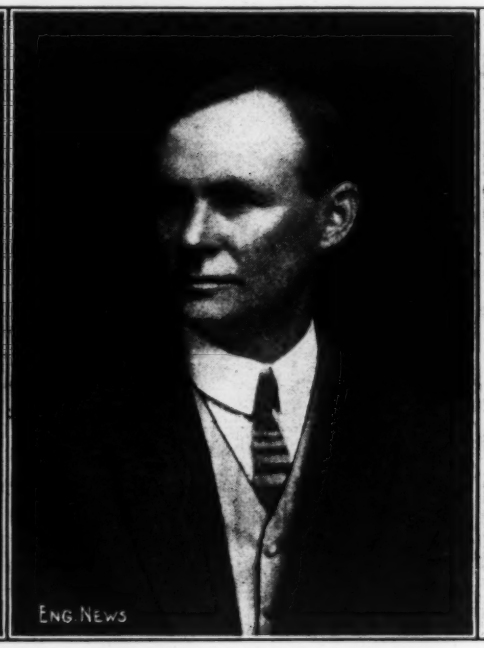
Funds for Road and Bridge Construction and Repair in Louisiana may be raised hereafter by means of a per capita tax and vehicle licenses as a result of a recent constitutional amendment.

The Railway-Valuation Board of the Interstate Commerce Commission

The Railway Valuation Act, which recently became a law, provides for the appraisal not only of all the railway property in the United States, but of the property of every common carrier subject to the Interstate Commerce Law at the present time or which may be brought under its jurisdiction in the future, which includes steamship, express and all transportation companies doing an interstate business. As stated in our editorial of Mar. 6, this work will involve a larger amount of engineering work and a larger outlay of money for engineering services than any public work ever before undertaken.

This immense task is to be done under the general supervision of the Interstate Commerce Commission, who are authorized to employ such experts as are deemed necessary. It has been unofficially stated that no less than 20,000 applications were received for positions, and that all subordinate positions are to be filled through civil service examinations. As noted in our Personal columns of last week, the Commissioners have already announced the appointment of five engineers, who will have charge of the organization of the staff and later have the direction of the field and office work. We are now able to present short biographical sketches and portraits of the engineers who are to direct this gigantic engineering undertaking.

R. A. THOMPSON



H. M. JONES

J. S. WORLEY

R. A. THOMPSON

Robert Andrew Thompson was born at New Waverly, Walker County, Texas, on July 11, 1869. He graduated from the University of Texas with the degree of Bachelor of Science in 1892, the following year he received the degree of Master of Arts, and in 1900 the degree of Civil Engineer. He is a member of the honorary society Phi Beta Kappa.

Before his graduation he had had several summers' experience as a rodman and topographer with the Texas State Geological Survey. In 1895 he was appointed Assistant Engineer of the Texas Railroad Commission, but during the latter part of the year he resigned to take charge of the construction of the sewerage system of Palestine, Tex.

In December, 1895, he entered the railway service as a levelman on construction of the Kansas City Southern Ry. in Louisiana and Texas. Later he was draftsman for the same railway. For the year 1897-'98 he was an instructor in civil engineering at the University of Texas. From this position he was appointed Chief Engineer of the Texas Railroad Commission, where he remained until 1909; during this period the Commission made a valuation of between 4000 and 5000 miles of railway.

Returning to railway construction work as Chief Engineer of the Wichita Falls & Northwestern Ry., Mr. Thompson had charge of the location and construction of some 300 miles of railway in Texas and Oklahoma. This railway is now a part of the Missouri, Kansas & Texas Ry. system.

Mr. Thompson was appointed Chief Engineer of the California Railroad Commission in October, 1911, and during the past year and a half has organized the engineering staff and begun the work of appraising the railways of the state; to date, some 1000 miles of the work have been completed.

Mr. Thompson is a member of the American Society of Civil Engineers.

WILLIAM D. PENCE

William David Pence was born at Columbus, Ind., Nov. 26, 1865. His first engineering work of importance was as Assistant Engineer and later as Resident Engineer of the Atchison, Topeka & Santa Fé Ry., 1886-1892. In 1892 he left railway work to become an instructor in civil engineering at the University of Illinois, where he was promoted successively to be Assistant Professor and Associate Professor. In 1895 he received the degree of Civil Engineer from the University of Illinois.

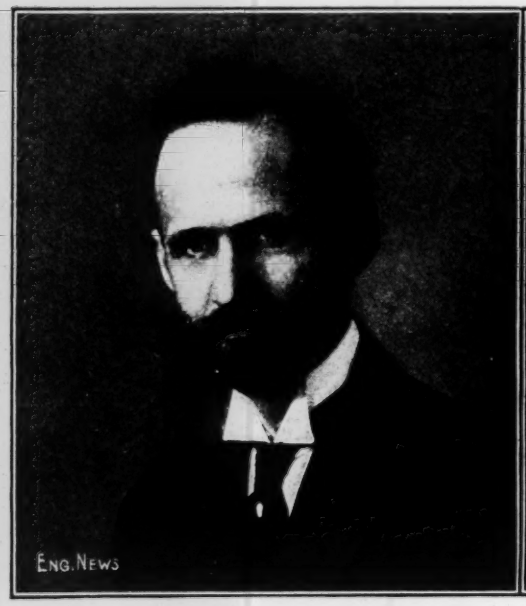
Prof. Pence was called from the University of Illinois to be Professor of Civil Engineering at Purdue University in 1899, and he remained at Purdue until 1906, when he was appointed Professor of Railway Engineering at the University of Wisconsin.

Besides his work as a teacher, Prof. Pence has always

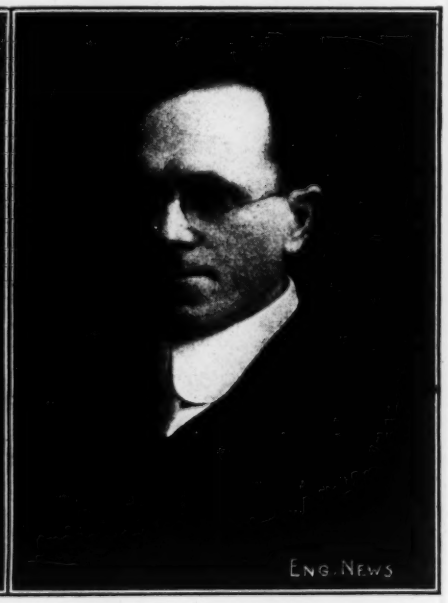
been actively engaged in outside engineering work. He was a member of the United States Commission on the drainage of the Kankakee marsh region in Illinois, 1904-1906, and since 1906 has been Chief Engineer of the Wisconsin Railroad Commission and the Wisconsin State Board of Assessment.

As Chief Engineer of the Wisconsin Commissions, Prof. Pence's work in the valuation of railway and public-utility properties attracted wide attention. The Wisconsin law requires the valuation of all the physical property and all the property used and useful for the convenience of the public belonging to every public utility in the state. The Wisconsin work has been widely used as a model for similar work elsewhere, and is noted for its comprehensiveness, fairness and thoroughness.

Prof. Pence is a member of the American Society of Civil Engineers, the Western Society of Engineers, the Western Railway Club, the Society for the Promotion of Engineering Education and is a Past-President of the Indiana Engineering Society.



W. D. PENCE



E. F. WENDT

JOHN S. WORLEY

John Stephen Worley is senior member of the firm of Worley & Black, Consulting Engineers, Kansas City, Mo. He was born at Oak Grove, Mo., in 1876. He received his technical education at the University of Missouri, where he spent two years, and at the University of Kansas where he graduated in 1903. He obtained a Master's degree at the University of Kansas in 1904.

Before entering the University of Kansas, Mr. Worley had obtained considerable experience in railway engineering work, and shortly after his graduation he was made Chief Engineer on the construction of the St. Louis & North Arkansas R.R. Later he left railway work to accept a position with the Riggs & Sherman Co., Consulting Engineers, Toledo, Ohio, as Principal Assistant Engineer on municipal improvement and appraisal work.

In 1909 Mr. Worley went to Kansas City, where he organized the J. S. Worley Co., with Ernest B. Black, who had also been with the Riggs & Sherman Co., as junior partner. Later the firm name was changed to Worley & Black. The work of this firm has included the design and supervision of construction of municipal improvements throughout the Central States, and during the past three years the firm has also handled appraisal work in connection with a number of public utilities. A part of Mr. Worley's recent work has been the preparation of evidence and the giving of expert testimony in various railway suits, and the examination of the physical properties of the Central of Georgia R.R. and the Buffalo, Rochester & Pittsburgh R.R. He has also served as Chief Engineer of the Kansas, Oklahoma & Southwestern Ry. and the Fort Scott & Pittsburgh Ry.

In 1912 Mr. Worley was Engineer in charge of an investigation of the methods of operation and accounting of the Delaware, Lackawanna & Western R.R., for the purpose of suggesting reforms and improvements to increase the efficiency of the railway organization.

Mr. Worley is an Associate Member of the American Society of Civil Engineers.

HOWARD M. JONES

Howard Murfree Jones was born in Murfreesboro, Tenn., Oct. 9, 1874. His early education was obtained in the public schools of his native city, and in 1891 he entered the civil engineering department of the Vanderbilt University, at Nashville, Tenn. After spending three years here, he went to Union College, Schenectady, N. Y., where he graduated in 1895, with the degree of Bachelor of Engineering.

The fall following his graduation he entered the service of the Nashville, Chattanooga & St. Louis Ry., at Nashville, as a clerk in the office of the Chief Engineer. He was promoted to be Chief Clerk and also served later as Assistant Engineer and Draftsman. In June, 1902, he left the railway to become Assistant Bridge Engineer with the Louisville Bridge & Iron Co., at Louisville, Ky., where he remained one year, after which he returned to the Nashville, Chattanooga & St. Louis Ry., being first appointed to the position of Chief Draftsman and later being promoted to the position of Bridge Engineer.

Mr. Jones opened an office for private engineering practice in Nashville, Jan. 1, 1907, making a specialty of bridge and reinforced-concrete design and construction. During the past six years he has designed and supervised the erection of two large reinforced-concrete bridges across the Cumberland River at Nashville, aggregating over a million dollars in cost, besides some 80 to 100 bridges of lesser importance. He has also designed and supervised the construction of a number of large reinforced-concrete buildings, and has acted as Consulting Engineer on several projects of considerable magnitude.

Mr. Jones is a member of the American Society of Civil Engineers and a Past-President and Director of the Engineering Association of the South. He also served the last named Society as Secretary and Treasurer for eight years.

The Typhoid Outbreak at Albany N. Y., Due to Flooded Filters

By Theodore Horton*

The typhoid fever outbreak which occurred at Albany, N. Y., in April, 1913, constitutes one of the most interesting and striking examples of an explosive epidemic due to a sudden, and, in some respects, accidental infection of a water-supply, resulting from the flooding of the slow sand filtration plant.

From Apr. 1 to May 5, inclusive, there were reported some 180 cases, certain detailed information concerning 175 of which I have been able to secure through the local Board of Health and show on the accompanying diagram. The first cases reported were on Apr. 21 and since that time additional cases have been reported daily

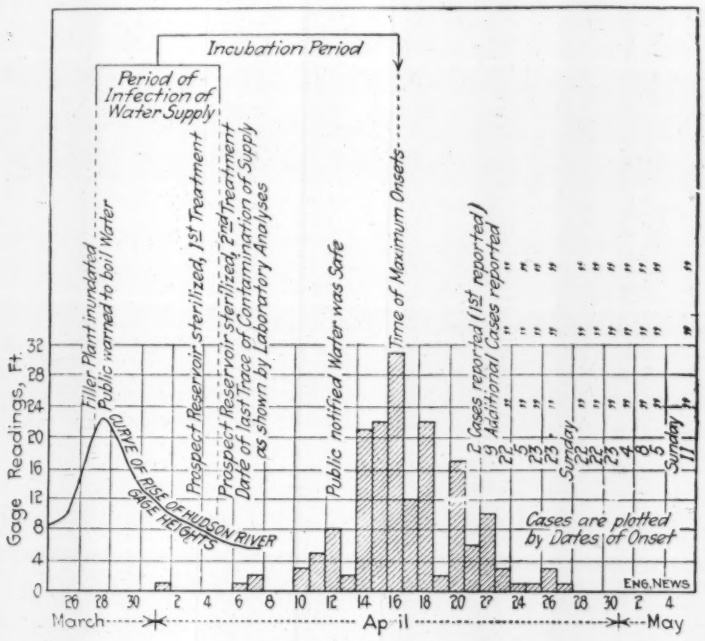

Incubation Period
Period of Infection of Water Supply
Filter Plant inundated
Public warned to boil Water
Prospect Reservoir sterilized, 1st Treatment
Prospect Reservoir sterilized, 2nd Treatment
Date of last Trace of Contamination of Supply as shown by Laboratory Analyses
Public notified Water was Safe
Time of Maximum Onsets
2 Cases reported (1st reported)
9 Additional Cases reported
CURVE OF RISE OF HUDSON RIVER GAGE HEIGHTS
Cases are plotted by Dates of Onset
Gage Readings, Ft.
ENG. NEWS
March
April
May

Diagram Showing Typhoid Outbreak at Albany, N. Y., Following the Flooding of the Water-Filtration Plant in March, 1913

until the number, as of May 5, reached about 180. Owing to the system adopted and in force by the Albany Health Department in reporting and investigating cases of communicable diseases, and to the unfortunate circumstances that Albany (with three other cities in this state) is exempt from the operations of the Public Health Law requiring that communicable diseases be reported to the State Department of Health, considerable difficulty was experienced in the beginning in getting closely in touch with the situation and in securing the necessary information to study and follow the progress of the epidemic.

Through the courtesy of the local Health Department, however, and upon special request and arrangements, the State Department of Health was able to secure without delay certain essential information of limited amount concerning nearly all cases reported. From these data it appears that of the 175 cases above referred to approximately 75% were among children and 25% among adults. Of the cases among children some 58% were males and 42% females; whereas of the cases among adults some 46% were males and 54% females.

*Chief Engineer, State Department of Health, Albany, N. Y.

The accompanying diagram shows more strikingly than I can describe the history of this epidemic which was, beyond a doubt, traceable to recent floods in the Hudson River which inundated and put out of service the filtration works located near the river just above the city. The events leading up to and immediately following the inundation of the filtration works were described in Engineering News of Apr. 10, 1913, which should be carefully read in order to understand intelligently the course, extent and relation of the present outbreak of typhoid fever to conditions during and immediately following the flood.

On the diagram have been plotted two curves or profiles: one showing the rise and fall of the Hudson River covering the period of the recent flood; the other, the number of cases of typhoid which have developed in the city up to May 5, inclusive, so plotted as to correspond with the dates of onset of the disease. On the diagram also appear a number of explanatory notes relating to water-supply and typhoid fever, arranged chronologically so as to show directly the relation between the two as to cause and effect. The vertical notes on the diagram explain important facts with reference to the flooding of the filter plant, notice to boil water, sterilization of Prospect Reservoir, the clearing up of all traces of pollution of the water-supply system; whereas the horizontal notes at the top of the diagram explain the relation between the incubation period, the period of infection of the supply and the time of maximum prevalence of typhoid fever.

This diagram strikingly pictures what occurred. It will be noticed that the maximum number of cases had their onsets on Apr. 16 and that the period of maximum prevalence covered a period of about one week. Allowing some two weeks for "incubation" and dating back on the diagram this period of time from Apr. 16, brings us directly to the period when infection of the water-supply took place. The diagram shows, therefore, at a glance, the close synchronous relation between the infection of the supply and the outbreak of cases.

Many things of unusual interest from an epidemiological standpoint occurred during the epidemic and appear on the chart that merit careful consideration and I will refer to them somewhat in detail:

The inundation of the filtration plant came with comparatively little warning and there was little time to notify the public to take precautions to boil the water. The city was substantially free from typhoid fever and the public mind was not, and could hardly be expected to be, aroused to the point of absolute necessity of observing precautions as it would have been had a typhoid fever epidemic been in progress, with the usual alarm that such a condition incites. It is, therefore, not surprising that in view of the warnings which appeared immediately in all the papers "to boil the water" these precautions were not strictly observed, as was obvious from the cases which developed later (see diagram).

Another feature in this connection is the large percentages of children which were stricken, 75%. This is also what would have been expected by anyone familiar with the juvenile mind. Children seem to have a particular aversion to boiled water, owing to its insipidity when not properly prepared and aërated. Contamination lingered in the water-supply system (due to raw river water getting into Prospect Reservoir) some days

after the high turbidity, at first apparent, cleared up. It is, therefore, easy to understand, as the records show, why children disregarded instructions and drank the more palatable water from the tap.

Another feature of much interest and importance, and referred to in detail in ENGINEERING NEWS of Apr. 10, was the sterilizing of Prospect Reservoir for correcting the contamination, and the institution of a series of laboratory analyses by the State Department of Health for the purpose of establishing a means whereby it would be possible to determine when the water-supply was safe and boiling of water unnecessary.

It will be recalled that the situation in the city was referred to the Department by the Governor in order that coöperation and counsel might be given the local authorities to avoid an epidemic. Although the damage had already been done the extent of it did not develop for two or three days. A close coöperation was, however, at once instituted between the city and state department of health. The filter plant was put in service as soon as the water receded sufficiently, the public having already been warned to boil all drinking water. A temporary hypochlorite disinfecting plant was installed, within 24 hours following. Flushing of water mains was immediately proceeded with. A plan was at once put into execution for systematically analyzing samples of water to be collected daily from the reservoirs and various taps over the entire city.

With the public already warned, and steps taken to put the filter plant into operation and thus furnish a pure supply to the city within a comparatively few hours of the time of recession of the flood, attention was immediately turned to investigating and clearing up the contamination which was known to have lingered in the distributing system. It was not for some two or three days, however, that the extent and seriousness of the contamination of one of the reservoirs was discovered and measures taken to correct it. The laboratory results revealed this and the local authorities were notified that the reservoir must be shut off or its sterilization undertaken without delay. Unfortunately, the piping arrangements made shutting off the reservoir impracticable. Sterilization was therefore resorted to and was undertaken first on Apr. 3. This was followed, two days later, by another treatment. I believe this is the first case on record of sterilization of a large open reservoir by the hypochlorite method and the results show that two treatments of about 1 part per million accomplished an entire elimination of B. coli type and acid colonies from the water in the reservoir.

The analyses from various parts of the distribution system in the city showed that whereas practically all traces of contamination disappeared from the central portion of the distributing system by Apr. 4, there still remained traces on the periphery of the system. The city was then requested to flush again the pipes in the outlying sections of the system. As a result, by Apr. 7 practically no trace of contamination was found in the reservoirs nor in any portion of the distributing system. Not until five days later, however, was the public notified that the water was safe to drink without boiling. This additional time was given as a factor of safety and with the idea that by waiting the full period of two weeks some indication might be obtained as to whether infection had occurred to any appreciable extent.

This brings me to one of the most important features in connection with the outbreak, namely, that although there were some 12 to 15 cases of typhoid fever actually in progress at the time that the people were notified that the water was safe, no cases were reported by the physicians until about Apr. 21 when, as shown by the diagram, over one hundred and fifty cases were in progress and the crest of the epidemic had apparently passed. In other words the epidemic, so far as the evidence now available indicates, had largely disappeared before the cases had begun to be reported. Of course some time is necessary for diagnosis but an important question apparently arises as to how much time is necessary for this purpose and especially as to whether in an emergency like this physicians cannot make their diagnoses more promptly and whether they should not err on the safe side and report even suspicious cases. A glance at the diagram would indicate that in the present instance there was considerable delay in the reporting of cases.

As an interesting sidelight on this particular feature, note on the diagram how few cases of onsets appear on Apr. 13, 17 and 19. The dates of onsets are by nature necessarily approximate and I am inclined to explain the low numbers on such dates as due to a possible psychological tendency, in reporting approximate dates of onsets, to select even numbered dates, with the exception, perhaps, of the fifteenth or middle of the month.

This epidemic is not devoid of a number of lessons which all such experiences seem to furnish. Among these may be mentioned in order the following:

(1) That in designing purification works situated under conditions as at Albany it is better to arrange them with a greater factor of safety against inundation (the recent flood having overtopped the tops of the filters a little over one foot).

(2) That sufficient available storage for a few days' supply might well be provided where there is any question as to inundation of purification works or other necessity for using impure raw water.

(3) That all reservoirs should be arranged so that they may be entirely shut off the distribution system in case of such emergency.

(4) That a mere *warning* to "boil water" when an epidemic is *not* in progress does not seem to deter a great many people from using contaminated water and makes all the more emphatic the necessity of maintaining at all times the integrity of purification works.

(5) That it is possible to sterilize effectively a large reservoir of water by hypochlorite treatment with fair success and that such emergency means should always be kept in mind by those responsible for its use in such cases.

(6) That physicians should be more prompt in reporting cases of typhoid fever, especially at a time when there is reason to fear that a water-supply has been infected. Time is necessary, of course, for diagnosis but even suspects should be reported in such an emergency.

(7) Local boards of health should be so provided with funds and facilities as to furnish at once the necessary information to follow closely from day to day the progress of an epidemic in order that they may take the necessary means for its suppression.

(8) The state after passing laws controlling the reporting of cases of communicable diseases should not by a series of exemptions make those laws applicable to only a part of the state.

(9) The people who drink water unboiled in an emergency like this in utter disregard of warnings from municipal and state authorities deserve to be severely criticized.

Fortunately, so far as the water-supply is concerned, this outbreak appears to have been largely if not almost entirely spent. With the water-supply free from contamination, if secondary cases can be avoided, and milk infection be prevented there would seem little to be feared from now on. The State Commissioner of Health has recently issued two letters of a general nature, one to each physician of the city of Albany urging all possible precautionary measures to prevent a spread through secondary infection; the other to all milkmen supplying milk in the city, instructing them how to prevent an infection of their supply by the sterilization of milk bottles by boiling water or steam, not leaving or taking milk bottles from houses containing typhoid patients, excluding typhoid cases or suspects from handling milk or milk utensils, and warning them that any infected supply found would be promptly excluded. In the letter of advice to physicians was the following suggestion:

> I venture to suggest that it would be well for you to administer typhoid vaccine to all of the members of every household in which you have under your care a case of typhoid fever. This department has a supply of this typhoid vaccine now on hand and will be pleased to furnish it upon request to all of the practicing physicians of the city for general use at this time.

No mention has been made of a consideration of other factors than water infection—nor in fact would any seem necessary. All such factors were, of course, carefully considered. Milk, from the considerable number of sources used by the different cases, showed no route in any particular way associated with the epidemic. Many spring and well waters were used during the flood when the city water was roily and these were peddled through the city from various sources outside the city. The possibility of these being a contributory cause of outbreak is not remote but on the face of it such waters could not have been polluted like the raw river water, nor could they all have been infected; furthermore, analyses which were taken of a number of them did not show any to be appreciably contaminated. None were associated with any "route."

Oysters were peculiarly a factor for consideration from the fact that one large hotel and one or two business places had oysters stored in the cellars which were flooded. No trace could be found, however, connecting these oysters with any case of typhoid fever in the city.

All of the cases have been plotted on a map of the city, which shows a fairly uniform distribution over the city—a typical *water infection* typhoid map, with, however, a preponderance of cases on the portion of the system connected with Prospect Reservoir. This fits perfectly the situation, since Prospect Reservoir was contaminated and contamination lingered and entered the portion of the system until this reservoir was sterilized. Of course contamination entered the other portion of the distribution system connected with Bleeker Reservoir and this contamination accounts for the cases on that system. The important point is, however, that the analyses showed that Bleeker Reservoir was not contaminated, as was the case of Prospect Reservoir (due to Bleeker Reservoir receiving a part of its supply from an upland gravity source, Rensselaer Lake, there being pumped into the distribution system connected with Bleeker Reservoir only an amount of water necessary to make up a deficiency in consumption), so that the infection disappeared rapidly from the system connected with Bleeker Reservoir as soon as the filtration plant was put into normal operation. The distribution systems of the Bleeker and of the Prospect Reservoirs are entirely separated, about one-half the city's population being served by Bleeker and one-half by Prospect. With, therefore, three-fourths of the cases on Prospect and one-fourth on Bleeker we have by comparison an indication of the relative significance of the contamination that entered Prospect Reservoir.

Although it is too early to say definitely that the epidemic is entirely over, the records of the local health department show that it has largely subsided. That is, the reported cases for the past four or five days show that only 4 or 5 cases have been reported each day as compared with the 22 to 25 cases of a week or more ago. It may also be stated that many of these cases reported within the past few days date back for onsets toward the middle of April, the time of maximum prevalence as shown by the diagram.

Additional cases must almost of necessity continue to be reported in the future but one would expect (I hardly dare express it more positively) them to be straggling reports either of cases with old onsets or else secondary cases from previous victims. It may at least be expected that with the full and explicit notices sent out by the State Commissioner of Health to the practicing physicians of the city and similar notices to the milkmen supplying milk that the avenues to these two sources of infection and further spread of cases will be effectually cut off.

⁂

A New Simple Engine for paper-mill use, has been developed by the American Engine Co., of Bound Brook, N. J. The most important features are (1) the use of four high-pressure cylinders in right-angle pairs, and (2) a close-regulating governor adjustable for engine-speed ranges of 10 to 1. Each pair of vertical and horizontal pistons drives a common crank pin, giving eight power impulses per revolution. A counterweight on each crank arm balances the thrust of the horizontal reciprocating masses on foundation and frame, while the vertical forces exerted by this counterweight are balanced by those of the vertical reciprocating parts. In this way, it claimed, smooth operation is secured so that the safe speeds can be pushed to as high as 500 r.p.m. The multiplication of power impulses per revolution also, it is held, results in sufficiently even torque for speeds down to 50 r.p.m.

Two throttling governors are used, one of which serves merely as an automatic safety speed-limit device. Close speed regulation, at each setting of the service governor, is required in paper-mill service or else breaking of the paper results. This governor is stabilized with springs and a dashpot between the throttling-valve stem and the governor balls. The latter are belt driven from the main engine shaft, but through two sets of friction disks and wheels. By changing the position of the wheels relative to the disks, the governor is made to operate at any desired engine speed. No attempt is made to vary the cutoff, since such a refinement is not needed where the exhaust is very largely used for heating. While accurate data on the performance of paper machines is not available, it is generally regarded by mill men and manufacturers that the power required varies directly with the speed, except at high and low extremes when similar extremes of power consumption would not be found. Accordingly, the builders believe that this engine has a straight-line speed-power diagram between the working speeds, though complete tests have not been made to show this. The torque is probably 25 to 50% greater at 50 r.p.m. than at 500.

The City Planning Conference at Chicago

The fifth National Conference on City Planning was held at the La Salle Hotel, Chicago, May 5 to 7. Only a few papers were presented, the purpose being to open up the subjects for discussion, and with this in view certain speakers were assigned to commence the discussions.

General Aspects of City Planning

A paper on "A City Planning Program" by Frederick Law Olmsted (Brookline, Mass.) dealt with the initiation and development of this work. An economic and financial survey must be made covering the city's present and prospective resources, the extent and rate of posisble expenditures for public improvements, and the probable future growth. The next steps must be to define the more important problems, and then to select and combine these into one definite, comprehensive and harmonious plan. The planning and execution must be done under complicated limitations and administrative conditions imposed by law, some of which serve mainly to block development and should be revised. As a future condition he predicted a permanent organization or authority in each large city, as follows:

> There will be some official body charged with the prime responsibility for the city plan. It will have records relating not merely to the physical aspects of the streets, public parks and buildings, but to the locations, grades, and other essential facts about all the sewers, conduits, pipes and subways beneath the surface of the streets. Also the poles and wires and other objects above the surface; railways and other means of public transportation; catchment areas and waterways, from the smallest gutters to the reservoirs and ponds, sewers, ditches, canals, and the rivers of the greatest flood capacity in the region. And finally records relating to every piece of land and every building and improvement, both public and private.
>
> As interpreter of the city plan, the office will report on every project under discussion as to whether it is or is not harmonious with the whole aggregation of accepted and approved projects. Its duty will be to recognize the march of unforseen events, whether fortunate or unfortunate, and if necessary alter the plan to meet the new conditions. One class of hard facts to be thus recognized will doubtless be the occasional disregard of the plan by the executive authorities of the city and the consequent establishment of permanent improvements.

The Committee on City Planning Study submitted a series of plans prepared by different landscape architects for a model section of 490 acres to be built within the limits of a city of 500,000 inhabitants, but four miles from the center of the city. The secretary, Flavel Shurtleff (Boston) made a report of progress for the year, showing what organizations exist and what work in this direction is planned by various cities.

A paper on "The City Planning Commission," by W. A. Magee (Mayor of Pittsburgh) was printed in abstract in our issue of May 7, 1913, p. 976, and a paper on controversies regarding these utilities.

The Land-Tax System for Public Improvements," by George E. Kessler (St. Louis) described the assessment for benefit system of raising funds for construction and maintenance of streets, boulevards and parks as practiced at Kansas City, Mo. An abstract of this paper will be given in a later issue of this journal.

Transportation Facilities and City Planning

This subject received more active interest and discussion than any other on the program. A paper by M. R. Maltbie (Public Service Commission, New York) showed that passenger and freight transportation is one of the important factors to be considered, and that good results cannot be obtained by adjusing the transportation to a complete plan which has been prepared without regard for this factor. Some of the points made may be noted as follows:

> (1) Main arteries should be straight lines.
>
> (2) When the growth of traffic necessitates the provision of separate lines for (A) urban and (B) suburban and inter-urban traffic, the latter should not be permitted to stop at the outskirts and transfer to the urban system. They should be required to operate through or across the city and do their own distribution and collection of traffic, as far as practicable.
>
> (3) Through lines should be adopted in preference to terminals.
>
> (4) Elevated lines are less costly than subways and have many advantages.
>
> (5) Freight should be delivered near the center of the city, and space utilized over and under freight yards. City and local electric lines can be used to distribute food products at night.
>
> (6) The municipality should have perpetual control over transit facilities, so that their development may keep pace with that of the city.

Several speakers pointed out the disadvantages of subways in regard to cost and sanitation, and suggested that while they must be used in certain congested districts, the tracks should come to the surface as soon as possible and be carried on elevated structures. It was stated also that many European city-planning schemes are defective in failing to give proper weight to the transportation problem. In fact several of these foreign schemes give undue prominence to the artistic and æsthetic aspects of the problem. In this connection, a note of warning was sounded for American cities which have a tendency to imitate foreign developments and to consider city planning mainly on the basis of "the city beautiful," to the exclusion of matters which are really of greater importance.

❖

Dedication of New Buildings at the University of Illinois

The formal dedication of the new Transportation Building (with the Locomotive Laboratory) and the Mining Laboratory, at the University of Illinois, Urbana, Ill., took place May 8, 9 and 10, and was participated in by a large number of invited guests. On May 9, two special cars were run from Chicago for a party composed of members of the Western Society of Engineers and the Western Railway Club. A railway conference was held in the morning of May 9, and in the afternoon a tour was made of the several buildings of departments related to engineering work, ending with the three new buildings noted above. The Locomotive Laboratory was described in our issue of May 8, and the operation of a large Illinois Central R.R. freight locomotive of the 2:8:0 class was watched by the guests with great interest. The Mining Laboratory includes a chemical department, a drills and explosives department, a mine station and a coal-washing and dressing plant. Professors in the various departments gave brief explanations of the plant and work under their charge.

Following this tour, the meeting assembled at the University Auditorium, where Dr. W. F. M. Goss, Dean of the College of Engineering, presided. Addresses were delivered by Dr. Edmund J. James, President of the University; W. L. Abbott, President of the Board of Trustees, and Willard Smith, President of the *Railway*

and Engineering Review. The entire party, headed by the band, then marched to the Transportation Building.

RAILWAY CONFERENCE—At this meeting a number of papers were presented relating to railways and railway education. Some of these were as follows: "Problems of the Steam Railway," B. A. Worthington, President of the Chicago & Alton R.R.; "Problems of the Electric Railway," W. B. McKinley, President of the Illinois Traction System; "Problems of the Manufacturer," Charles B. Moore (Jacobs-Shupert Firebox Co.) and George R. Henderson (Baldwin Locomotive Works); "The Technical Society as an Influence in Education," Albert Reichmann, President of the Western Society of Engineers. Other speakers were D. F. Crawford, President of the American Railway Master Mechanics Association; T. H. Goodnow, President of the Western Railway Club; H. G. Hetzler, President of the Chicago & Western Indiana R.R.; W. L. Park, Vice-President of the Illinois Central R.R.; Robert Quayle, Superintendent of Motive Power, Chicago & Northwestern R.R.; Samuel O. Dunn, Editor of the *Railway Age Gazette,"* and H. E. Chubbuck, Manager of the Illinois Traction System.

Mining Conference—At two meetings held May 9 and 10, the papers dealt with the commercial, engineering, labor and practical mining points of view. The more technical papers included the following: "Concrete in Mine Construction," A. F. Allard, Chief Engineer of the Bunsen Coal Co.; "Steel in Mine Construction," by Carl Scholz, President of the Coal Valley Mining Co.; "Modern Steel Tipple Design," by John A. Garcia, Consulting Engineer, and "The Fireproofing of Mining Plants" by Herbert M. Wilson, National Fire Protection Association.

❖

Transportation Facilities and City Planning*

BY MILO R. MALTBIE†

In discussions of city planning there has been a noticeable lack of consideration of transportation facilities, with the exception of the public highway. The commuting zone is generally limited to the area which can be reached within 45 or 60 minutes from the heart of the city, and usually the great mass of population is within a half-hour radius. It is not so much a question of distance, as of time and convenience of travel. The area which may be reached varies with the square of the radius, so that if it is possible to go twice as far from the center in one city as it is in another during the same length of time, the available area is four times greater in the first instance. And with the same population the density of the area inhabited need be but one-fourth of what it is in the second case. Then single houses of two stories in height may house the same population that would in the second case of necessity be housed in tenements, solidly built, of from four to six stories.

Districts with attractive housing schemes may be planned, but people will not and cannot live there unless they are served with cheap and rapid transportation.

THE VALUE OF STRAIGHT STREETS

There is a marked tendency among city planners to use curved streets and streets that constantly change their direction. But the old statement holds true that the curved line is for pleasure and the straight line for business. On rapid transit lines with frequent curves operating expenses would be increased because the loss of energy (in acceleration and retardation) and the cost of maintenance and repairs would be heavy. Curves reduce speed; reduced speed means increased time in transit; this means a reduction in the area which can be served, which in turn is a cause of congestion.

Compare the elevated roads in Manhattan with those in Brooklyn. The former have few curves and hence good speed. In the central portion of Brooklyn, the lines are so crooked and complicated with numerous crossings and connections that trains must be operated slowly. As a result one can travel on the 3rd Ave. elevated line in Manhattan 50% further in the same length of time from City Hall Park than by any of the elevated lines over the Brooklyn Bridge.

The main arteries of traffic should be as nearly straight as the topography will permit. But in residential areas between main lines of traffic, there is ample room for exercise of ingenuity in street layouts which may be beautiful and attractive. But these areas ought not to be planted where they will interfere with the extension of through transportation lines.

RAPID TRANSIT LINES

It is obvious that as buildings increase in height, the demand for transportation increases. In the lower part of New York, the street plan is practically the same as it has been for generations. All of the available streets will soon be occupied by rapid transit lines for the transportation of passengers. Unless additional streets are to be cut through at enormous expense, it will be necessary to limit the height of buildings and thus diffuse congestion, or to construct subways on lower levels. In addition, provision must be made for the transportation of materials, and even now it is apparent that if they are to be handled economically, some provision must be made other than the distribution by truck from distant freight terminals.

Passenger terminal stations should be eliminated so far as possible. They are costly to acquire, expensive to maintain, and increase rather than decrease congestion. So far as possible, railway lines should be operated through a city and not terminate therein.

Through lines should not be permitted to unload their passengers at the outskirts of the city and to compel the urban lines to distribute their traffic. They should be obliged to operate lines through the heart of the city and so far as possible distribute their own business.

It is essential that the interurban and steam lines be so located that they shall have a relation to the purely urban facilities. The stations upon the through lines should coincide with express and local stops on the urban rapid transit lines, and the surface lines should radiate from local as well as express stations. Increased speed means increased capacity and a greater area of service. It is also cheaper to carry persons upon express trains than upon trains that make every stop, provided there is a sufficient number to fill these express trains and to utilize the tracks at some time of the day to their capacity. The tracks upon which trains make every stop should have stations at frequent intervals, but if the stations are too close together, the line ceases to be a rapid transit line. The proper adjustment of these facilities is one of the most difficult problems of city planning.

In the New York subway, the idea of local and express service on parallel tracks was worked out quite successfully and was a distinct contribution to the science of urban transportation. Experience has shown, however, that the relation of express to local stations was not so adjusted as to secure the greatest utility for every track. During rush hours the express tracks are loaded to their maximum capacity and trains of ten cars are run at intervals of 1¾ min. The service on the local tracks at no time of the day reaches the maximum capacity of those tracks. The maximum number of cars in a train is six and the minimum headway is about 1¾ min. The ratio of use between the local and express tracks is, therefore, about three to five. The explanation is that the express stations are not far enough apart to distribute the traffic properly. In the new lines an attempt has been made to remedy this condition by placing the express stations further apart.

SUBWAYS OR ELEVATED LINES

The question of cost is a factor which must not be overlooked. The success of subways in a few cities has given rise to the idea that every city should have subways and that all will be profitable. This is a mistaken notion. Subways are easily operated, but they are expensive to construct and this means large fixed charges. In order to offset this burden, there must be dense traffic or many persons riding short distances. Dense traffic, however, means congestion of population. Areas given over to private houses, each with its own grass plot and garden, cannot furnish a sufficient population to support a subway unless the ride is very short and the rate of fare high. But to have single houses, people

*Abstract of a paper read before the City Planning Conference, Chicago, May 5-7.

†Member of the Public Service Commission, New York, N. Y.

must go some distance from the center of the city and then the ride is long. If the fares are high, the great mass of the population cannot afford to pay them.

More attention should be given to reducing the cost of rapid transit lines. A subway is the most expensive kind that can be built. The old-style elevated road is much less expensive, and the solid-floor or so called "noiseless" type stands between the two. Elevated lines are more comfortable than subways, having better ventilation and light.

FREIGHT TRANSPORTATION

The transportation of property is not less important than that of passengers, and in every plan of city development provision should be made for a prompt and cheap method of distribution. Thus far the railways and steamship companies have assumed that their function ended with the provision of terminal facilities somewhere within the boundaries of the city. Not infrequently these terminals are located upon the periphery of the city and usually considerably removed from the consumer and the factory, so that products have to be transshipped and hauled long distances by wagon or motor truck. In metropolitan centers such a plan is quite unsatisfactory.

The maintenance of terminals in the heart of the city is very expensive, but thus far sufficient consideration has not been given to the correlation of various factors. The yards are commonly large areas where only the surface is utilized. No use is made of the space either above or below the tracks, and seldom has any attempt been made to bring warehouses and factories into close proximity. The distribution of food products represents a somewhat different problem. These must go to every home, and consequently the facilities for distribution must reach every part of the city. In this connection the country and city electric lines have not been fully utilized. During the night time and early morning hours these lines are practically unused. The cost of operating cars at these times would entail practically no fixed charge and the operating expenses would be small.

In the largest cities it will probably be necessary within the near future to provide special means for freight transportation. The situation has almost reached this stage in New York, and propositions have already been made for the construction of subways and elevated lines for this kind of service.

MUNICIPAL CONTROL OF TRANSIT FACILITIES

As long as the various transportation facilities are in the hands of private individuals and controlled by different corporations, it is obvious that they cannot be brought into correlation and each made to serve the public in a proper way without a superior force. Each one ought not to be permitted to carry out its own wishes regardless of its relations to other facilities. It is absurd that a company should locate a terminal removed from other transportation facilities and insist that the city should provide means for the distribution of the traffic which it brings to this inconvenient point. Moreover, conditions change and what is proper and adequate in one generation is often inadequate and ill suited to the demands of the succeeding generation. Consequently, there must be public control, not only over the first location or first scheme of development but over future development also. The city should always be in a position where it can dominate the situation.

❖

The Land-Tax System or Benefit Assessments for Public Improvements in Kansas City, Mo.*

By George Kessler†

The land-tax method [assessments for benefits.—Ed.] is applied in Kansas City, Mo., to provide funds for permanent improvements, inclusive of the establishment and maintenance of the park system. But little street improvement is made out of general revenue and only the principal trunk line sewers are paid for by general taxation or by bond issues. All else is done by means of special assessment against benefited land. In the case of special assessments for particular improvements, these assessments lie against the lands only, in no case taking the improvements thereon into account.

When a street or boulevard is to be established, widened or lengthened the city proceeds in the local civil courts to expropriate or condemn the necessary land. The cost of the land thus taken is then assessed against the private lands within a prescribed benefit district. In the case of streets this is usually abutting land. In the case of boulevards custom has established the frontage upon the adjoining parallel street on each side as properly within a district specifically benefited by the establishment of such improved highways.

The grades are then established, and should there be great changes of ground surface opportunity is given to claim damages, the cost of which is assessed as a special land assessment against the properties in the benefited district. The highway is then graded, and the cost of this work assessed in proportion to the value of the property assessed and against the lands forming the normal frontage on the highway so improved. The cost of sewerage is assessed against the lands within the area to be served, on the basis of cost in proportion to its area.

The city then further proceeds to build the curbs, the paving and the sidewalks, assessing all of these elements against the abutting properties in proportion to the frontage.

The city may (but does not, as a rule) further assess the abutting properties with the cost of establishing the lawns on the sidewalk spaces. It does assess the cost of shade-tree planting and care upon the abutting property in the case of the streets. On the boulevards, the Park Commission provides for tree planting and lawns on the sidewalk spaces. The city does not assess for the establishment of water mains, and the installation of lighting equipment is an incident to the general contract for lighting, paid for out of the general revenue.

The park and boulevard system is administered by a Board of Park Commissioners. It has the exclusive power of selection, no powers of legislation, but exclusive powers of administration. It began 20 years ago to plan (under the writer's direction), but acquisitions were not accomplished until approximately 1896. Since that time to the middle of April, 1913, the expenditures have aggregated $11,680,000; 82.3% of this provided by special assessment and 17.7% by general taxation. The Park Department had no hope of aid from current revenue, and the city's debt-making power had reached its limit for the purchase of the water-works. In applying, therefore, the principle of benefit assessments for the creation, improvement and maintenance of this park system, there were established certain assessment districts used as unit areas of taxation. Provision was made for the collection of the special assessments in instalments, which have ranged from 10 to 20 years, generally the latter. In order that there should be no necessity for waiting until the end of the 20-year term to obtain the funds necessary to pay for the properties taken, provision was made for the issue and sale of securities known as park-fund certificates, which found favor with large investors and have always found prompt and ready sale, indeed always at some slight premium.

For the purpose of improving and maintaining the parks and boulevards, and in the absence of sufficient current revenue appropriated by the legislative body, there was established a power to assess annually within the limits of each park district (and for the sole benefit of that district) every parcel of private land within that district. It was found desirable also to assess annually a low maximum charge against the abutting private properties for the exclusive purpose of maintenance. As a low limit was finally placed upon the powers of the city to make the annual maintenance levies, the Park Department was given all of the vehicle-license tax collected by the city.

One difficulty of the maintenance levy is that the older park districts naturally contain the high-value business areas, thus obtaining ample revenues for improvement and maintenance, while the outlying and intermediate districts, having comparatively low values, obtain insufficient funds. Therefore, there must each year be obtained from the current general revenues a sufficient apportionment to the Park Department for the expenditures necessary in these districts beyond their local district revenues. This becomes particularly true of the large outlying park, the entire cost of improvement and maintenance of which must necessarily be borne out of current revenues.

In effect this system has placed the Kansas City Park Department in a semi-independent condition with reference to its funds, and has made it possible to accomplish results that would have been entirely out of the question under any other financial system in that city. In practice this entire procedure is an amplification of the theory of the single tax [on land only.]

---

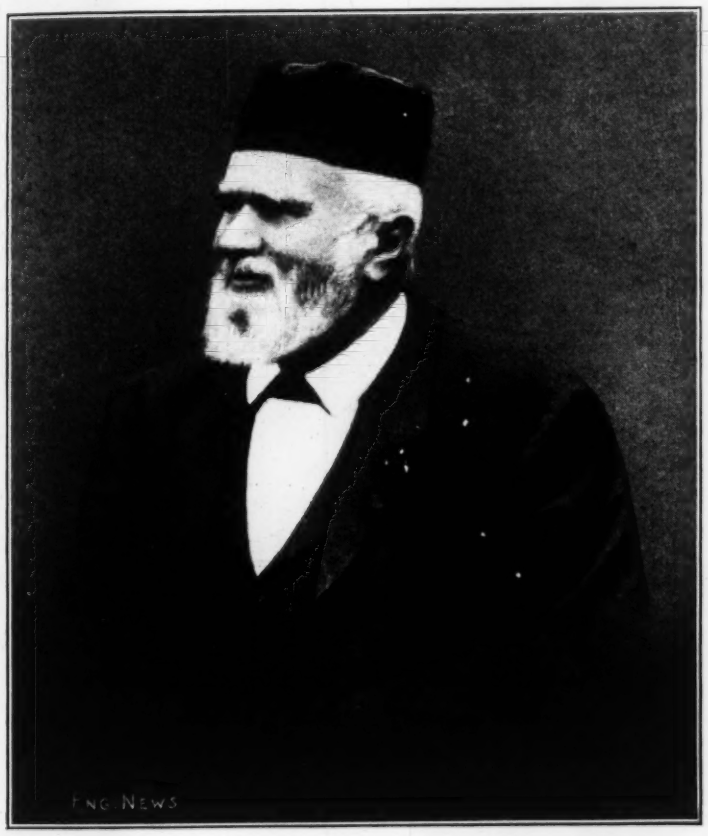
*Abstract of a paper read at the City Planning Conference, Chicago, May 5, 8.

†Landscape Architect, St. Louis, Mo.

Adolphus Bonzano*

Adolphus Bonzano, President of the Bonzano Rail Joint Co., and formerly a prominent bridge engineer, died at his home in Philadelphia, Penn., May 5. He was born at Ehingen, on the Danube, Wurttemberg, Germany, on Dec. 5, 1830. His early education was received at the gymnasia of Ehingen and Blönsdorf and at Stuttgart, but when still a boy his father emigrated to Texas, where, with others who emigrated about the same time, a considerable German colony was established.

In 1850 Adolphus and one brother went to Philadelphia, where he remained for two years to study and to perfect himself in the English language. He then went to Springfield, Mass., where he entered the machine shop of the American Machine Works as an apprentice. After



ADOLPHUS BONZANO

a few years he was made superintendent of the works, and in 1855 he was sent to New Orleans to take charge of the erection of the engines and machinery built at Springfield for the United States Mint.

For several years he was engaged with the mechanical departments of various railways and in machine shops. In 1865 he was made Superintendent of Construction of the Detroit Bridge & Iron Works at Detroit, Mich., and thereafter devoted the greater part of his life to bridge and structural engineering. While with the Detroit Bridge & Iron Works he had charge of construction of the great bridge over the Mississippi River at Quincy, Ill., of which the late Thomas Curtis Clarke was Consulting Engineer.

In 1868 Mr. Bonzano went to Phœnixville, Penn., to become associated with Mr. Clarke, who had organized the bridge building firm of Kellogg, Clarke & Co. Of this firm he was a prominent member and its Chief Engineer. In 1870 the firm was reorganized on the retirement of Mr. Kellogg, and became Clarke, Reeves & Co., with whom Mr. Bonzano remained as Chief Engineer.

Under his direction some of the most notable iron bridges in this country and Canada were constructed, including among many others, the Hudson River bridge for the New York Central & Hudson River R.R., at Albany, N. Y., the Girard Ave. bridge in Philadelphia, the Second, Sixth, Eighth and Ninth Ave. elevated railways in New York City and the famous Kinzua viaduct on the Erie R.R.

In 1884 the firm of Clarke, Reeves & Co. was dissolved and a stock company was organized under the name of the Phœnix Bridge Co., of which Mr. Bonzano was Vice-President and Chief Engineer until 1893. During these years the company built many now famous structures, including the Pecos viaduct for the Southern Pacific Ry. in Texas, the Red Rock bridge of the Atlantic & Pacific Ry. over the Colorado River Cañon, and the trainshed of the Philadelphia terminal of the Philadelphia & Reading Ry. From 1893 to 1898 he was associated with Mr. Clarke as a consulting engineer with offices in New York City. In 1898 he retired from active professional work to devote his entire attention to the development of his inventions of railway and engineering appliances, of which the well known rail joint, which bears his name, is one.

Mr. Bonzano was a member of the American Society of Civil Engineers, the American Society of Mechanical Engineers, the American Institute of Mining Engineers and the Canadian Society of Civil Engineers.

In addition to his accomplishments as an engineer, inventor and manufacturer, he was a talented musician, a skillful pianist, organist and choirmaster. His genial and kindly manner endeared him to his many friends in all walks of life. Few bore him greater love and loyalty than his former employees, in whom he kept up a lively interest all through the years after his retirement from active business life.

He is survived by two sons, Maximilian Ferdinand, a well known engineer of Philadelphia, and Hubert.

*From data furnished by John C. Trautwine, Jr., 257 S. Fourth St., Philadelphia, Penn., and by M. G. Lippert, Chief of Drawing Room, Phoenix Bridge Co., Phoenixville, Penn.

❖

A Locomotive Boiler Explosion occurred on the Missouri Pacific Ry., near Tipton, Mo., on May 4. A brakeman and the fireman were seriously scalded, but no one was killed.

A Mississippi River Flood-Rescue Steamer, the "Concordia," collided with a railway bridge at Clayton, La., on May 2, and sank with 130 refugees on board. All but 22 persons were rescued. It is reported that the "Concordia" sank while engaged in similar work last year, but was raised and repaired.

Three Runaway Freight Cars collided with a passenger train on the Grand Trunk Ry., near Oxford, Mich., on May 1. The cars had run on a half-mile down grade when they met the locomotive of a passenger train coming in the opposite direction. The engineman was fatally injured and 25 passengers received more or less severe injuries.

An Explosion of Dynamite in the magazine of the Sunshine Coal & Coke Co., Mine 1, about 3 miles from Masontown, Penn., on May 10 practically obliterated the little mining settlement there. Three men were killed and about 40 persons were injured, half of them seriously. The cause of the explosion is not known.

A Hole in 12-Ft. Brick Sewer in Johnson Ave., Brooklyn, N. Y., caused a street cave-in on May 6. It is believed the failure was due to a leak in a 20-in. water main laid above the sewer. A 1½-in. pipe tap in the main had come out, and a stream of water under 50 lb. pressure had been directed against the haunch of the arch, and had forced a hole through it. The sewer was built about 25 years ago. Street cars had been passing over the cavity left by the washed-out material up to within a few minutes before the final cave-in.

The Collapse of a Temporary Sidewalk at Geary and Mason Sts., San Francisco, Calif., on May 2, caused serious injuries to a score or more people in a dense crowd just leaving a theater. The temporary plank walk had been erected earlier in the same day by contractors who had begun the excavations for an adjoining building. The structure is reported to have been 50 ft. long and 10 ft. wide and to have collapsed the entire length under the weight of some 200 people, who were crowded upon it. Howard C. Holmes, M. Am. Soc. C. E., Consulting Engineer, of San Francisco, is said to have been on the sidewalk at the time, and Mr. Holmes is quoted by the San Francisco "Chronicle" as follows:

> There was no swaying motion to the sidewalk, so I should judge that its collapse was not due to lack of sway bracing. We were right in the middle of the sidewalk and it seemed to me that it just gave way and sank vertically. That would indicate that the foundation on which the uprights rested was not firm.

Flood Damage to the Pennsylvania Lines. Northwest System and Central System (i.e., excluding the Panhandle) is stated by R. Trimble, Chief Engineer of Maintenance-of-Way, to be as tabulated:

	N. W. system	Central system
Bridges lost, No.	6	6
Bridges damaged, No.	15	6
Spans lost, No.	8	16
Spans damaged, No.	14	11
Bridges lost, length, ft. road	400	2,142
ft. single track	725	2,142
Bridges damaged, length, ft. road	944	1,230
ft. single track	1,675	1,230
Estimated cost of replacing bridges	$265,336	$351,920
Trestle, single track, mi.	0.06	1.13
double track, mi.	0.25	...
Total mi. road	0.31	1.13
mi. single track	0.56	1.13
Estimated cost of trestles	$39,954	$119,560
Roadbed requiring repairs, single track, mi.	1.7	36.5
double track, mi.	16.5	0.7
three track, mi.	1.1	...
four track, mi.	2.2	...
Total mi. road	21.5	37.2
mi. single track	46.8	37.9
Estimated cost of repairs to road	$210,800	$542,885
Station and other buildings, damage	5,350	17,750
Equipment, damage	3,800	6,350
Telegraph lines, damage	28,305	17,500
All other damage	10,190	20,735
Total estimated loss	$563,735	$1,076,700

The Commission Plan of City Government was adopted at Portland, Ore., on May 3. An election will be held in June for five commissioners, including a mayor, and for an auditor.

The San Francisco Municipal Railway will soon be running cars from the Ferry to the Beach, under authority granted on Apr. 22, by a popular vote of 38,089 to 21,920. This vote was in ratification of an agreement between the United Railroads and the city, under which the city appears to be given trackage rights on lower Market St. and the company is to be permitted to run its Sutter St. cars down Market St. to the Ferry, instead of turning them on a loop at Sutter and Market St., as at present. The city will build two tracks for a short distance (Kearney to Sansome St.) on Market St., from the city end of its present Geary St. line, and will also build from 33d Ave. to the Beach, at the other end. Horse cars on lower Market St. will be abolished.

The Three Bids for a Water-Filtration Plant for Wilmington, Del., received on Apr. 30, 1913, have been rejected upon the recommendation of Ezra B. Whitman, water engineer. In readvertising, the work will be divided in the hope of securing more competition than resulted from including structural work and filter equipment in one contract. The three bids received on Apr. 30 were: Keystone State Construction Co., Pennsylvania Building, Philadelphia, $971,187; New York Continental Jewell Construction Co., 15 Broad St., New York, $982,563; Oscar Daniels Co., Woolworth Building, New York, $1,016,526. On filter equipment alone the bids, in the order above given, were: $385,000; $367,699; $375,000. The detailed bids are given in our Construction News columns.

PERSONALS

Mr. A. N. Carver, Division Engineer of the San Benito & Rio Grande Valley R.R., at San Benito, Tex., has resigned.

Mr. K. A. Dumphy has been appointed Resident Engineer on the Alberta division of the Canadian Pacific Ry. at Calgary, Alta., succeeding Mr. J. Robertson.

Mr. Ralph W. E. Donges, of Camden, N. J., has been elected President of the Board of Public Utility Commissioners of New Jersey, succeeding Mr. Robert Williams, of Patterson, N. J.

Mr. George A. Ricker, M. Am. Soc. C. E., of Ricker & Minniss, Buffalo, N. Y., has been appointed First Deputy Highway Commissioner of New York State at a salary of $6000 per annum.

Mr. Joseph E. Crawford, M. Am. Soc. C. E., Bridge Engineer of the Norfolk & Western Ry., Roanoke Va., has been appointed Acting Chief Engineer, succeeding Mr. Charles S. Churchill, M. Am. Soc. C. E., assigned to special duty.

Mr. W. L. Huber, Assoc. M. Am. Soc. C. E., until recently District Engineer, U. S. Forest Service, has opened offices at 417 Foxcroft Bldg., San Francisco, Calif., for practice as a consulting engineer, specializing in water power and structural engineering.

Mr. Bernard L. Eaton, formerly Superintendent of Construction with the Porto Rican Irrigation Service, at Juana Diaz, Porto Rico, has been appointed Erecting Superintendent of the turbine department of the I. P. Morris Co., Philadelphia, Penn.

Mr. John D. Patterson, Superintendent of Terminals of the Louisville & Nashville R.R., at Atlanta, Ga., has been appointed Superintendent of the Panama R.R., with headquarters at Colon, Panama, succeeding Mr. B. M. Smith, resigned. For many years Mr. Patterson was a passenger conductor on the Southern Ry.

Messrs. H. B. Pullar, Assoc. Am. Soc. C. E., formerly Assistant Manager and Chief Chemist of the American Asphaltum & Rubber Co., Chicago, Ill., and C. H. Enzenroth, for some time associated with Mr. Pullar, have formed a partnership under the firm name of Pullar & Enzenroth, Engineering Chemists, with offices and laboratory at 378 Woodward Ave., Detroit, Mich.

Mr. Charles A. Ferry, M. Am. Soc. C. E., formerly associated with Mr. A. B. Hill, M. Am. Soc. C. E., Consulting Engineer, New Haven, Conn., has opened an office in the Benedict Bldg., New Haven, for the general practice of civil engineering. Mr. Ferry's design for the new Yale University football ampitheater has recently been adopted and construction work will be begun at once.

Prof. Daniel W. Mead, M. Am. Soc. C. E., of the University of Wisconsin, has been appointed Engineer to represent the interests of the city of Peru, Ind., in the reconstruction of the railway bridge over the Wabash River, which was destroyed by the recent floods. It is claimed by the city authorities that the old bridge acting as a dam was in some measure responsible for the flood conditions in the city.

Mr. Carmi A. Thompson, formerly Treasurer of the United States, has been appointed General Manager of the Great Northern Ry. ore properties in Minnesota. It is announced that after the expiration of the United States Steel Corporation's lease in 1914, the properties will be operated independently by Mr. James J. Hill and his associates who own them. The headquarters of the mining company will be in St. Paul, Minn.

Mr. W. H. Banck, formerly Junior Engineer of the U. S. Engineer Department and recently in charge of a survey for the proposed harbor of refuge at Cape Lookout, has opened an office in the Garrell Bldg., Wilmington, N. C., for the general practice of civil engineering. Mr. Banck is a graduate of the Agricultural and Mechanical College of North Carolina and has been engaged in work for the United States Government since graduation.

Mr. G. A. Rodman, formerly Inspector of Bridges of the New York, New Haven & Hartford R.R., has been appointed General Supervisor of Bridges and Buildings in charge of the inspection of all bridge and building work to be done by the maintenance-of-way department, with headquarters at New Haven, Conn. The office of Superintendent of Bridges and Buildings is abolished and duties hitherto performed by that officer are assigned to the Division Engineers.

Prof. Henry H. Norris, F. Am. Inst. E. E., head of the department of electrical engineering at Cornell University, has resigned to become a member of the editorial staff of the "Electrical World," New York City. Prof. Norris was born in Philadelphia, Penn., in 1873. He received an M. E. degree from Cornell University in 1896. He was made Assistant Professor of electrical engineering at Cornell in 1900 and Professor in 1905.

Dr. A. J. Orenstein, has resigned his position at Assistant Chief Sanitary Inspector, Panama Canal. He goes to Hamburg, Germany, to enter the Colonial Institute in that city, with the view of later entering the German Colonial Service in Africa. He entered the canal service on Nov. 6, 1905, was stationed for a time at the Colon and Ancon hospi-

tals, later was appointed district physician at Ancon, and Assistant Chief Sanitary Inspector in May, 1911.

Messrs. Edmund T. Perkins, M. Am. Soc. C. E., President and Chief Engineer of the Edmund T. Perkins Engineering Co., Chicago, Ill.; Isham Randolph, M. Am. Soc. C. E., Consulting Engineer, of Chicago, Ill.; and Marshall O. Leighton, M. Am. Soc. C. E., Chief Hydrographer of the United States Geological Survey, Washington, D. C., have been appointed a State Engineering Commission to investigate and report upon the reclamation of the Florida Everglades by drainage.

Mr. A. R. Whaley, who was recently elected Vice-President of the New York, New Haven & Hartford R.R., in charge of operation, has been appointed to take charge of the engineering, construction and maintenance-of-way department also, succeeding Mr. E. H. McHenry, M. Am. Soc. C. E., resigned, as previously noted in these columns. Mr. Whaley has introduced a number of changes in the organization of the engineering department, which are noted elsewhere in these columns.

Mr. William R. Driver, Jr., formerly General Superintendent of the Bell Telephone Co., of Philadelphia, Penn., has been appointed General Manager of the New England Telephone & Telegraph Co., at Boston, Mass., succeeding Mr. Francis A. Houston, who has been appointed Treasurer of the company. Mr. Driver is 41 years old. He was born in Beverly, Mass., and educated at Harvard University. He entered the engineering department of the New England Telephone & Telegraph Co., in 1893.

Mr. J. W. Barrie, formerly Division Engineer of the Pennsylvania R.R. lines West of Pittsburgh, has been appointed Principal Assistant Engineer of Maintenance-of-way of the Florida East Coast Ry. Mr. Barrie was born in Dundee, Scotland, in 1875. He graduated from Ohio State University in 1897. After graduation he entered the service of the Pennsylvania R.R. as an assistant in the engineering corps of the Pennsylvania Co. For several years he was Engineer of Maintenance-of-way of the Toledo division.

Mr. Robert A. Cairns, M. Am. Soc. C. E., City Engineer of Waterbury, Conn., was the recipient of an honorary dinner by his friends and prominent citizens of Waterbury, on Apr. 29. The object of the dinner was to publicly express the appreciation of the city's business men of Mr. Cairns' decision to remain loyal to his city work rather than accept the Governor's offer of the position of State Highway Engineer of Connecticut. Mr. Cairns has been City Engineer of Waterbury for 22 years—through many changes in the city administration and through many changes of the dominant political party.

Mr. H. Gilliam, Electrical Superintendent of the New York, New Haven & Hartford R.R., will hereafter have charge of the maintenance, distribution and control of all electrical apparatus and high-tension wires from the crossarms outside the switch-house to the shoes of the locomotives, which includes the high-tension primaries of all transformers and switches connected with the distribution system. On all matters relating to operation he will report to the Division Superintendents. He will also act in an advisory capacity for all high-tension lines heretofore maintained by the Signal Engineer.

Mr. W. J. Backes, M. Am. Soc. C. E., former Chief Engineer of the Central New England Ry., has been appointed Engineer of Maintenance-of-way of the New York, New Haven & Hartford R.R. and the Central New England Ry. He will have charge of the maintenance of tracks, bridges, buildings and signals. The Division Superintendents are to report to the Engineer of Maintenance-of-way on all matters within his jurisdiction. The Division Engineers will report to and receive instructions from the Division Superintendents. They will report to the Engineer of Maintenance-of-way on matters pertaining to the inspection of physical property, construction and standards of maintenance other than signal standards, on which they will report to the Signal Engineer.

Mr. A. R. Whaley, Vice-President of the New York, New Haven & Hartford R.R., in charge of operation and construction, has made the following changes in the organization of his departments: Mr. Edward Gagel, M. Am. Soc. C. E., Chief Engineer, will have charge of the engineering department and will have jurisdiction over all matters pertaining to construction and standards; Mr. C. L. Bardo, General Manager, will have charge of all matters pertaining to transportation, maintenance of equipment, power stations, high-tension lines, track, signals, bridges and buildings. The Engineer of Maintenance-of-way, General Superintendent, Mechanical Superintendent, Electrical Superintendent, Signal Engineer, Superintendent of Telegraph, Contract Agent and Superintendent of Dining Cars will report to the General Manager.

Mr. Edward Gagel, M. Am. Soc. C. E., Chief Engineer of the New York, New Haven & Hartford R.R., has announced the following appointments to offices under the Chief Engineer at New Haven, Conn.: Mr. A. S. Tuttle, formerly Division Engineer of Construction, Boston, Mass., is appointed Construction Engineer in charge of grade-crossing elimination in Massachusetts; Mr. C. W. Lord is appointed Office Engineer at New Haven, in general charge of the drafting department; Mr. W. H. Moore, M. Am. Soc. C. E., formerly Engineer of Bridges is appointed Engineer of Structures in charge of the design of all bridges and structures; Mr. L. J. Carmalt, M. Am. Soc. C. E., formerly Engineer of Maintenance-of-way, is appointed Construction Engineer in charge of work on the Central New England Ry. The office of Assistant Chief Engineer of the Central New England Ry. is abolished.

The New York, New Haven & Hartford R.R. General Manager has announced the following changes in the mechanical department: Mr. G. W. Wildin is appointed Mechanical Superintendent, with office at New Haven, Conn.; Mr. George O. Hammond is appointed Assistant Mechanical Superintendent, and the position of Assistant to the Mechanical Superintendent is abolished; Mr. H. C. Oviatt is appointed Assistant Mechanical Superintendent, and the position of General Inspector is abolished; Mr. J. L. Crouse is appointed Superintendent of Shops, Electric Division, with headquarters at Van Nest, N. Y.; Mr. Joseph McCabe is appointed Master Mechanic of the Shore Line division at Harlem River, N. Y.; Mr. C. H. Reid is appointed Master Mechanic of the Western division at Waterbury, Conn.; and Mr. F. W. Nelson is appointed General Road Foreman of Engines, with headquarters at New Haven, Conn. The jurisdiction of the Mechanical Superintendent is extended to cover the maintenance of electric locomotives or multiple-unit cars, and the operation and maintenance of power stations up to and including the lines at the crossarms outside of the switch-house.

OBITUARY

Peter E. Bowman, a former Division Superintendent of the New York, New Haven & Hartford R.R., died at his home in New Haven, Conn., on May 9, aged 65 years.

Samuel L. Cooper, M. Am. Soc. C. E., City Engineer of Yonkers, N. Y., died at his home in that city May 8. He was born in New York City in 1858, and graduated from the College of the City of New York. For ten years he was with the engineering department of the City of New York, and for five years was Resident Engineer of the old Croton aqueduct. Later he was an examining engineer in the New York City finance department.

Alfred Brittain, M. Can. Soc. C. E., of Montreal, Que., died at his home in that city, May 6, from pneumonia. He was born in England 72 years ago, the son of James Brittain, also an engineer. Alfred Brittain went to Canada in 1866 as an officer of the Royal Engineers of the British Army. A short time later he resigned from the Army to become City Engineer of Montreal. During his 35 years' of service with the city a large part of the present sewerage system was planned and constructed under his supervision.

Frank O. Briggs, for many years connected with the firm of John A. Roebling's Sons Co., engineering contractors and suspension bridge builders, of Trenton, N. J., died May 8. He was born on Aug. 12, 1851, and graduated from the United States Military Academy at West Point, N. Y., in 1872. He resigned from the Army five years later to enter the employ of the John A. Roebling's Sons Co., builders of the Brooklyn Bridge. He had been Assistant Treasurer of the company since 1883. Mr. Briggs was Mayor of Trenton from 1899 to 1902, a member of the State Board of Education 1901-'02, State Treasurer of New Jersey 1902-1907, and in 1907 he was elected United States Senator from New Jersey.

Charles Walker Raymond, M. Am. Soc. C. E., Brigadier-General, Corps of Engineers, U. S. A., retired, died at his home in Washington, D. C., May 3. He graduated from the United States Military Academy at West Point in 1865. For some years he was an instructor in engineering subjects at the Academy, and later was in charge of the government scientific expedition to Northern Tasmania to observe the transit of the planet Venus. For two years, 1889-1890, he was Engineer Commissioner of the District of Columbia, and later was connected with many river and harbor improve-

ment projects on the Atlantic and Gulf coasts. He was a member of the board of advisory engineers of the Pennsylvania R.R. on the construction of the Hudson and East River tunnels at New York City. He was retired from the Army in 1904 at his own request.

James Cooper Bayles, Past-President of the American Institute of Mining Engineers, and for many years Editor of the "Iron Age," died in New York City, May 7, at the age of 68 years. He was born in New York in 1845 and obtained his early education in the public schools of the city. He served in the Union Army during the Civil War, and afterward joined the engineering staff of the Raritan & Delaware Bay R.R. From 1868-69 Mr. Bayles was Editor of the "Commercial Bulletin," of New York City, resigning this post in 1870 to become Editor of the "Iron Age," New York City. This position he held for 19 years, and during this period, in 1884-'85, he served as President of the American Institute of Mining Engineers and as President of the New York City Health Department. Mr. Bayles received the degree of Ph.D. from Rutgers College and was the recipient of many other honors. He was President of the New Jersey State Sanitary Association in 1884. He was a charter member of the American Society of Mechanical Engineers and a member of the Iron and Steel Institute of Great Britain. He is survived by two sons, both engineers, Lewis P. Bayles, of Easton, Penn., and Howard Bayles, a mining engineer in Chile.

Alexander Benjaminovich Bary, a famous Russian engineer and financier, died Apr. 19, at his home in Moscow, Russia. He was born in Russia and educated in the Voronieje Gymnasia (classical), but owing to the emigration of his family he was obliged to finish his studies at the Polytechnic Institute at Zurich in Switzerland. Soon after his graduation he came to the United States where he went through many interesting experiences. He was a fireman and laborer in iron works, draftsman, and finally Superintendent of Construction for buildings at the World's Fair in Philadelphia in 1876. He returned to Russia and became associated with the Russian promoter and financier, Ludvig Nobel, who employed Bary to organize some petroleum works in Baku. As manager of Lugvig Nobel's engineering work Bary developed extraordinary engineering and executive ability and he soon started in business on his own account. In Moscow he organized the Russo-American Co. for refining petroleum products, founded the Moscow Naphtha Trade Association, the Mitisetchensky Car Building Works and a large boiler manufacturing plant. He was also a builder of bridges, boats and locomotives. To the end of his life he retained the executive control of his many enterprises and even personally financed them. He was the contractor for all the buildings at the All-Russias Exhibition in 1896 at Nigni-Novgorod and for the enormous docks at St. Petersburg. Mr. Bary was the first Russian manufacturer to introduce a nine-hour working day for his laborers. He is said to have been plain in manner, sympathetic, and to have gained and held the friendship and loyalty of his many employees. He was a multi-millionaire and famous as a philanthropist. (From data furnished by Gustav Lindenthal, Consulting Engineer, New York City.)

ENGINEERING SOCIETIES

COMING MEETINGS

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.
May 20. Annual business meeting at New York City. Secy., F. L. Hutchinson, 33 W. 39th St., New York City.

NATURAL GAS ASSOCIATION OF AMERICA.
May 20-22. Annual meeting at Cleveland, Ohio. Secy., N. W. Gifford, 26 Central Square, East Boston, Mass.

AMERICAN RAILWAY ASSOCIATION.
May 21. Spring session at New York City. Secy. W. F. Allen, 75 Church St., New York City.

SOUTHWESTERN ELECTRICAL AND GAS ASSOCIATION.
May 21-24. Annual meeting at Galveston, Texas. Secy., H. S. Cooper, 405 Slaughter Bldg., Dallas, Texas.

NATIONAL ASSOCIATION OF MANUFACTURERS.
May 19-21. Annual meeting at Detroit, Mich. Secy., G. S. Boudinot, 30 Church St., New York City.

AMERICAN ASSOCIATION OF DEMURRAGE OFFICERS.
Mar. 20-23. Annual meeting at Chicago, Ill. Secy., A. G. Thomason, 834 Old South Bldg., Boston, Mass.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS.
May 20-23. Spring meeting at Baltimore, Md. Secy., C. W. Rice, 29 W. 39th St., New York City.

INTERNATIONAL RAILWAY FUEL ASSOCIATION.
May 21-24. Annual meeting at Chicago, Ill. Secy., C. G. Hall, 922 McCormick Bldg., Chicago, Ill.

OHIO SOCIETY OF MECHANICAL, ELECTRICAL, AND STEAM ENGINEERS.
May 22-24. Annual meeting at Springfield, Ohio. Secy., F. E. Sanborn, Columbus, Ohio.

MASTER BOILER MAKERS' ASSOCIATION.
May 26-29. Annual meeting at Chicago, Ill. Secy., Harry V. Vought, 96 Liberty St., New York City.

NATIONAL DISTRICT HEATING ASSOCIATION.
May 27-29. Annual convention at Indianapolis, Ind. Secy., D. L. Gaskill, Greenville, Ohio.

NATIONAL ELECTRIC LIGHT ASSOCIATION.
June 2-6. Annual convention at Chicago, Ill. Secy., T. C. Martin, 29 W. 39th St, New York City.

AMERICAN RAILWAY MASTER MECHANICS' ASSOCIATION.
June 11-13. Annual convention at Atlantic City, N. J. Secy., J. W. Taylor, Old Colony Bldg., Chicago, Ill.

ASSOCIATION OF RAILWAY ELECTRICAL ENGINEERS.
June 16. Semi-annual meeting at Atlantic City, N. J. Secy., Jos. A. Andreucetti, Room 411, C. & N. W. Ter, Sta., Chicago, Ill.

MASTER CAR BUILDERS' ASSOCIATION.
June 16-18. Annual convention at Atlantic City, N. J. Secy., J. W. Taylor, 390 Old Colony Bldg., Chicago, Ill.

TRAIN DISPATCHERS ASSOCIATION OF AMERICA.
June 17-19. Annual meeting at Los Angeles, Calif. Secy., John F. Mackie, 7122 Stewart Ave., Chicago, Ill.

AMERICAN SOCIETY OF CIVIL ENGINEERS.
June 17-20. Annual convention at Ottawa, Ont. Secy. Charles Warren Hunt, 220 W. 57th St., New York City.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.
June 23-26. Annual convention at Cooperstown, N. Y. Secy., F. L. Hutchinson, 33 W. 39th. St., New York City.

AMERICAN WATER-WORKS ASSOCIATION.
June 23-28. Annual meeting at Minneapolis, Minn. Secy., J. M. Diven, Troy, N. Y.

PERMANENT INTERNATIONAL ASSOCIATION OF ROAD CONGRESS.
June 23-28. Congress at London, England. Secy., W. Rees Jeffreys, Queen Anne's Chambers, Broadway, Westminister, London, S. W.

SOCIETY FOR THE PROMOTION OF ENGINEERING EDUCATION.
June 24-26. Annual meeting at Minneapolis, Minn. Secy., H. H. Norris, Cornell University, Ithaca, N. Y.

AMERICAN SOCIETY FOR TESTING MATERIALS.
June 24-28. Annual convention at Atlantic City, N. J. Secy., Edgar Marburg, University of Pennsylvania, Philadelphia, Penn.

CANADIAN ELECTRICAL ASSOCIATION.
June 25-27. Annual convention at Toronto, Ont. Secy., T. S. Young, 220 King St. West, Toronto, Ont.

AMERICAN INSTITUTE OF CHEMICAL ENGINEERS.
June 25-28. Semi-annual meeting at Boston, Mass. Secy., J. C. Olsen, Polytechnic Institute, Brooklyn, N. Y.

American Institute of Mining Engineers—The annual convention will be held in Butte, Mont., Aug. 18-21. A stop will be made at Great Falls, Mont., on Aug. 16. The secretary is Bradley Stoughton, 29 W. 39th St., New York City.

Illuminating Engineering Society—The Philadelphia section of the society held a joint meeting on Apr. 23, with the Philadelphia Gas Works section of the National Commercial Gas Association and the Philadelphia Electric Co. section of the National Electric Light Association. The paper of the evening was on "Industrial Lighting," by Thomas W. Rolph, of the Holophane Works of the General Electric Co.

Concrete Institute—A report on algebraic symbols for use in structural calculations (on wood, steel or concrete) was submitted at the Apr. 24, 1913 meeting of the Concrete Institute by the Science Standing Committee, Chairman E. Fiander Etchells. The report discusses various principles which should govern the choice and relative typographical characteristics and sequence of different symbols, i.e., letters standing for different quantities; it then presents a series of notation tables specifically designed for formulas and analyses in (a) structural engineering generally, (b) reinforced concrete, (c) structural steel, (d) brickwork and masonry, (e) timber. Most of the elements of the notation depart entirely from that customary in the United States. The presentation of the report was followed by discussion by F. E. Wentworth-Sheilds, Prof. Henry Adams, W. A. Green and H. K. Dyson.

International Meeting of Consulting Engineers—A congress or international meeting of consulting engineers and professional experts or referees is to be held during the Universal Exposition in Ghent, Belgium, July 17-22. It will be held under the auspices of the Belgian organization, Chambre Syndicale des Ingénieurs Conseils en matière d'Installations Industrielles, of which R. E. Mathot is President, and Chas. de Herbais de Thun is Secretary. Membership in the congress will be in two classes, paying respectively 100 francs and 20 francs, with no difference in rights. However, anyone may secure the publications of the congress, without taking membership, by the payment of 10 francs. The question of founding a federation of consulting engineers' associations will be touched upon. Other parts of the program schedule are allotted to discussions on organization, professional questions, fees and charges, and related subjects. Subscriptions for membership should be sent to Mr. de Thun, 18 Rue Marie-Thérèse, Brussels, Belgium.

ENGINEERING LITERATURE

CONTENTS

REVIEWS:

	Page
Cost Reports for Executives. Reviewed by Rossiter R. Potter	1031
The Gas Turbine. Reviewed by H. F. Longwell	1032
An Expensive Experiment	1033
Rivers and Estuaries, or Streams and Tides	1033
The Theory and Practice of Mechanics—Analytical Mechanics. Reviewed by Lewis E. Moore	1034
Chaudieres a Vapeur, Machines a Vapeur	1034
The Design of Alternating Current Machinery. Reviewed by Eric A. Lof.	1035
Earthwork Haul and Overhaul. Reviewed by S. S. Roberts	1036
Building Construction	1036
Elements of the Precision of Measurements and Graphical Methods. Reviewed by N. E. Do sey.	1037
Steam Boilers; Their Theory and Design	1037
Diagrams for the Solution of the Kutter and Bazin Formulas for the Flow of Water. Reviewed by John H. Gregory	1037
Machine Design. Reviewed by John J. Flather	1038
Steam Boilers	1038
The Practical Railway Spiral. Reviewed by W. W. Colpitts	1039
Schubwiderstand und Verbund in Eisenbetonbalken	1039
Structural Details of Hip and Valley Rafters...Hip and Valley Designs; Details, Formulae and Graphics	1039
PUBLICATIONS RECEIVED	1039

REVIEWS AND NOTES

Practical Working Cost Systems

Reviewed by ROSSITER R. POTTER*

COST REPORTS FOR EXECUTIVES, As a Means of Plant Control—By Benjamin A. Franklin. New York: The Engineering Magazine Co. Cloth; 6x9 in.; pp. 149; with numerous record forms. $5.

An introduction by the editor of the "Engineering Magazine" announces that this volume is made up from a series of articles by Mr. Franklin published in that journal in 1912. Unlike some books assembled from magazine articles, Mr. Franklin's has not suffered in the process. In fact it presents a coherence and logical sequence of chapters which suggests that ultimate publication in book form was contemplated when the articles were first written.

The author's aim is to discuss the value and uses of a practical cost system from the standpoint of the plant manager. He does not, therefore, enter upon any detailed explanation of how to build up a cost system, but points out what a cost system can be made to show when once successfully installed. In the opening chapter on "The Philosophy of Costs," he discusses the general requirements of an ideal cost system and the mental qualifications and viewpoint necessary to get the most out of it. Chief among the qualifications specified are imagination and what the author terms the practical instinct. Imagination comes into use in enabling the executive to visualize the shop conditions represented by the cost reports, while the functions of the practical instinct are to devise methods of improving these conditions and to prevent the compiling of masses of figures which can be put to no practical use.

The first requirement advanced by the author for an ideal cost system is that it shall be operated in connection with the regular bookkeeping. In this way the bookkeeping system can be made to afford a proof of the correctness of the cost figures. If, as the author puts it, the cost system is "put through the bookkeeping system," the trial balance can be made to prove the situation at the end of each month by showing in totals for the whole plant what the cost system shows in detail for separate articles or lots. Perhaps the chief feature of the specimen trial balance shown is a statement of the separate profit or loss on each class of goods manufactured. The author explains that such a trial balance is the final culmination of the cost system. The reader is assured, moreover, that such a trial balance can really be produced monthly without prohibitive expense. In line with his requirement that the cost system be proven through the regular bookkeeping system, the author advises against the practice of basing selling prices on costs estimated by building up from details, unless these costs are checked by working back from the total expense shown by the books. He repeatedly emphasizes the importance of working back from easily proven total costs to individual or detail costs, and warns against business failures due to unproven cost estimates.

Mr. Franklin's three chief subdivisions of cost are the usual ones of materials, direct labor and expense. He discusses in some detail the points to be brought out by cost reports on these three subdivisions, devoting a separate chapter to each. The specimen forms given in these chapters, and in fact throughout the book, are most helpful. They are of a general nature designed to be suggestive of forms suitable for any one of a wide range of businesses. However well arranged, cost reports are of no use, Mr. Franklin explains, unless they are intelligently interpreted and acted upon. He urges the advantage of making the reports accessible to all those of the business organization who can play a part in bringing about cost reductions. Coöperation of the whole executive force is best secured, be believes, in this way. To get the full benefit of the cost reports, statistics must be kept for purposes of comparison and record. In a chapter on this subject, the author discusses both statistics of costs and statistics of related subjects, such as volume of sales, salesmen's results and advertising results.

Mr. Franklin admits, even insists, that a cost system is not an easy thing to install. Plenty of persistence and time are necessary, and in fact "it takes from one to two years time, in a plant of any size, to build a good system." Cost systems may fail to be of any value through the indifference of the chief executive in neglecting to see that a thorough and complete system is installed and in neglecting to get an understanding of the system which will enable an intelligent use of the information revealed by it.

But the author is positive that a right cost system properly used is well worth the trouble. In his final chapter, the cost system is eulogized as the basic improvement for the scientific study of management methods. In this connection, one of the author's comments is worth quoting:

> One thing ought to be clearly understood, viz., that despite the constant talk of systems of all kinds, and their value, no business is made a success by them alone. Business success is made by policies, energy, enthusiasm, work and sagacity. In a struggle of brains versus system, brains will usually win. System * * * * * * assumes importance only as intelligence, persistence, and energy wield it.

The adoption of a standard cost system (devised by Mr. Franklin) by the National Association of Machine Tool Builders may have suggested the Government Bureau of Industrial Research proposed in the concluding chapter. One of the tasks for this bureau would be the establishment of uniform cost systems for the various industries. The comparative costs obtained by the uniform systems would then be of use in the regulation of matters that have to do with prices and profits, for example in the adjustment of the tariff.

The chief fault of the book is one of rhetoric. Mr. Franklin not infrequently tries to make one sentence do duty for two or three, crowding in more ideas than can be absorbed by the average reader at one reading. There is never any ambiguity, however. The most complex of the sentences are plain enough when the meaning has been carefully traced through, and Mr. Franklin's ideas, like the cost system he writes of, are usually worth the effort.

In closing this review, the writer wishes to call the attention particularly of the younger engineers to the field open to them in the introduction and development of practical working cost systems. A very little study of the literature of the subject will enable the technically trained man to grasp the essential points. And when once the technic and terminology of costs is mastered, the engineer is in a far better position than the average accountant to arrange even the ultimate details of a cost system. This is because the design of a cost system requires the practical accuracy of the engineer rather than the laborious minuteness of accuracy habitual with accountants.

⁂

A preliminary outline of "A City Planning Classification," designed to meet the need of both city planners and librarians, has been prepared by Prof. J. S. Pray and Librarian Theodora Kimball, of the School of Landscape Architecture, Harvard University (Cambridge, Mass.; price 10c.). The com-

*Production Engineer, Blood Bros. Machine Co., Kalamazoo, Mich.; formerly Assistant Editor, Engineering News.

plete work will be published in June (50c.). The preliminary and shorter classification was published for the sake of obtaining criticism at the City Planning conference, held at Chicago, May 5 to 7.

The Holzwarth Gas Turbine

Reviewed by H. E. LONGWELL*

THE GAS TURBINE: Theory, Construction, and Records of the Results Obtained from Two Actual Machines—By Hans Holzwarth. Translated by A. P. Chalkley, A. M. Inst C. E. Philadelphia; J. B. Lippincott Co. Cloth; 6x9 in.; pp. viii+140; 142 text illustrations. $2.50.

This work is not a general treatise on the gas turbine, but is limited strictly to an analysis and description of the particular type of gas turbine built after the author's designs. Before taking up the book itself a paragraph may be devoted to a description of this turbine.

The Holzwarth gas turbine has a series of combustion chambers arranged in a circle around the axis of the rotor. These combustion chambers have inlet and discharge valves operated hydraulically or mechanically. The combustible charge is introduced into the combustion chamber at a pressure only slightly above that of the atmosphere; it is ignited in the usual manner; and the pressure rises to 6 or 7 atmospheres. The exhaust valve opens, and the products of combustion expand through a nozzle which directs them against the blading of the turbine rotor. Fresh air is next blown through the combustion chamber for scavenging and cooling purposes, and the cycle is repeated. Each combustion chamber acts just like the cylinder of a reciprocating engine working on the Lenoir cycle, with air scavenging, but without a piston. While the action of the combustion chamber is intermittent, resulting in a series of puffs against the turbine wheel, the effect of a plurality of these chambers working in rotation is to produce a turning effort that is practically continuous. The air and gas may be delivered to the combustion chamber by low-pressure blowers, or the turbine may discharge through a rotary exhauster which maintains a slight vacuum in the turbine so that the charge may flow into the combustion chamber by atmospheric pressure. The auxiliaries — compressors or exhausters — are driven by steam turbines, the steam being generated by heat recovered from the exhaust of the gas turbine.

The book is divided into four parts, dealing respectively with the Theory of the Gas Turbine, the Construction of the Gas Turbine, a General Comparison with the Reciprocating Engine, and Results of Tests.

Part I occupies practically one-half of the text. It discusses, from a thermodynamic standpoint, the several processes which go to make up the cycle: charging, ignition, combustion, expansion, and scavenging. It also contains sections on the influence of the size of the combustion chamber, the utilization of exhaust heat, the principles of regulation and other kindred matters.

This part is intensely mathematical. It is decidedly hard reading, because: (1) The style is more or less obscure; (2) there are a considerable number of typographical errors; (3) the symbols used in the various equations are not systematically defined, and in many instances their significance has to be determined by inference from the equations themselves; and (4) on account of the confusion arising from a lack of continuity in the meanings attached to the symbols. For example, at the outset, H indicates the heat content of one kilogram of gas; further on it represents the head corresponding to the velocity of the expanding gases at the nozzle. The ratio of the specific heat at constant pressure to the specific heat at constant volume is represented indifferently by K, $\frac{1}{x}$ and γ. The latter symbol has also the added burden of representing the specific gravity of the gas and its specific heat as well.

In the summary of this part of the work, it is stated that:

The foregoing theory of the gas turbine does not serve as a guide for the calculations of the turbine, but explains the influence of the various factors on the gas turbine process.

In making this statement, the author evidently does himself an injustice, as most of the reported powers and efficiencies seem to be the results of calculations made in accordance with the theory as developed, rather than results derived from actual experiment.

Part II (20 pages) gives the reader a clear and fairly comprehensive idea of the construction of the 1000-hp. turbine that was actually built and tested, together with several suggested variations in the design. It illustrates and describes the general arrangement of the complete machine, together with details of the combustion chambers, rotor, valves, governing mechanism, ignition apparatus and auxiliaries, including the waste heat boiler.

Part III, General Comparisons, contains an interesting defense of the Lenoir Cycle, and a table and some drawings showing the advantages of the 1000-hp. gas turbine over a reciprocating gas engine of equal power, in the matters of weight and space required for installation. The text also discusses the superiority of the turbine over the reciprocating engine from an operating standpoint.

It is in Part IV, Results of Tests, that the reader will experience the keenest disappointment. The first section (14 pages) is devoted to tests on the original gas turbine built in 1908 and tested in 1908-9. This entire section may be summarized in the statement that the cycle proved to be workable, and that the author succeeded in burning various liquid fuels, such as petrol, gas-oil, petroleum, benzol, tar-oil, etc., and that judging from the appearance of the exhaust, the combustion was complete.

There are six tabular reports of these tests (each of which lasted for approximately an hour) but in addition to remarks on the appearance of the exhaust, the data given are only the mean temperature in the combustion chamber, maximum pressure, stroke of fuel pump, fuel per charge, and r.p.m. of cam shaft, none of which seem to be particularly significant. Nothing is said about the speed of the turbine, the power developed, or the efficiency.

An unusually amusing error of translation appears in this section. For each of the several liquid fuels tested, there is a statement of the heat value of the fuel in calories per kg., cost in marks per 100 kg., and energy per hp. in calories. At first thought, this latter figure would appear to indicate the efficiency obtained. However, as the "energy per hp." varies all the way from 540 to 2320 calories, this would indicate —on the assumption that the energy per horsepower per hour was meant, that the efficiency varied between 26 and 113%.

On careful examination it develops that the figure is not energy per hp. at all, but is the energy per pfennig, calculated by dividing the calorific value of 100 kg. of the fuel by the price. The translator has evidently taken it for granted that Pf. (the abbreviation for 0.01 mark) was an abbreviation for Pferd, the German word for horse.

The succeeding 14 pages are taken up with a description of the experiments on the 1000-hp. turbine used for driving a dynamo. The only mention of operating results is given in a single paragraph on page 119:

> In February, 1911, the turbine was run on no load, with full excitation 4000 volts, at 3000 r.p.m., consuming only 250-300 cu.m. of gas per hour with a heat content of 1179 calories. This corresponds to an efficiency of over 20% (if the air resistance of the rotor be taken with that of the dynamo rotor). This was certainly a satisfactory starting point for the efficiency curve.

There are no tests of gas consumption under different loads, and there is indeed no direct statement that the turbine ever carried any load whatsoever. From a diagram on page 123, showing the hp. per combustion chamber in relation to the pressure, it might be inferred that determinations of the hp. per chamber indicated that if all ten chambers had been in operation, the total maximum power developed would have been as much as 450 hp. It was found, however, by experiment that with all of the chambers in action, the scavenging was imperfect, and the power developed per chamber was on that account considerably reduced.

The book closes with an Appendix discussing sundry questions raised by Dr. Stodola in a review of the German edition of this work. Table I in this Appendix gives elaborate data on performances and efficiencies under many different conditions of initial temperature and with loads ranging from 275 to 928 hp. It is a bit disheartening to find on referring to the text that this table does not set forth results of actual tests, but only the calculated probable results of purely hypothetical tests.

Over 40% of the illustrations are reproductions of indicator diagrams showing the intensity and duration of the explosions in the combustion chamber. These diagrams are not critically analyzed, and have such a monotonous similarity of appearance as to suggest mere padding rather than anything of essential interest.

While one might be inclined to suspect that this work was written more with the object of promoting sundry patents than with the object of making a serious contribution to the literature of the subject, it will nevertheless be interesting to those who wish merely to inform themselves regarding the nature of the theoretical cycle adopted by the author, and the mechanism which he devised for reducing it to practice. To those who are looking for specific information in regard to actual powers and economies, the book will prove disappointing.

*Consulting Engineer, the Westinghouse Machine Co., East Pittsburgh, Penn.

Criticisms of the Ontario Hydro-Electric Power Commission

AN EXPENSIVE EXPERIMENT—The Hydro-Electric Power Commission of Ontario. By Reginald Pelham Bolton, M. Am. Soc. C. E., author of "Building for Profit" and "Elevator Service." New York: The Baker & Taylor Co. Toronto: McClelland & Goodchild, Ltd. Cloth; 5x8 in.; pp. 281; illustrated. $1.25, net.

While the author gives this volume a modest title, yet he makes a most severe arraignment of the ideals and efforts of the Ontario Hydro-Electric Power Commission. This body, it will be recalled, was organized to study the wider general utilization of the water powers of Ontario, where fuel is scarce and costly, and has since put into service a huge transmission system from Niagara Falls besides three other minor developments.

The book aspires to be an engineering and economic study of the work of the Ontario Commission. The first seven chapters, comprising some 60% of the book, are intended to be broad discussions of hydraulics and economics involved in hydro-electric power developments in general and municipal projects in particular, together with a brief historical outline of the Ontario movement, and a discussion of the commercial value of scenic attractions like Niagara Falls.

Probably the interest of an engineer reader will largely lie in Chapters VIII and following, where the author more definitely analyzes the Commission's figures of building and operating the Niagara transmission system, and describes alleged conditions under which the three minor projects were started. Mr. Bolton secured his figures through a "public spirited Honest Man" of retiring disposition, who prefers to remain anonymous (an employee of the Commission perhaps). It is true that full and uptodate reports of the Commission's expenditures, etc., have only very recently been published, but that is the usual way with such documents.*

Mr. Bolton, in his preface, announces that he has "written impartially from the standpoint of an engineer, a property owner, a taxpayer and a citizen deeply interested in the general welfare of the public," in order to prevent, if possible, a similar threatened experiment by New York State. On the face of things, it would appear that the author is a bit disingenuous. His book seems to have been part of a well organized campaign of the electricity supply industry to head off the movement for a state owned hydro-electric system; notices of it occupied large and high-priced advertising spaces in the New York daily papers—a publicity that has been afforded only in the case of a few "best sellers" in the fiction line. Furthermore the author's contemporaneous work for one of the greatest steam-electric companies in the state may have subconsciously influenced his judgment against hydro-electric developments and the Ontario Commission; absolute fairness would have been aided by the acknowledgment of such professional affiliations or engagements in the preface.

Mr. Bolton's specific studies of depreciation, running expenses, rate contracts, character of competition, and adequacy of services will stand very much closer scrutiny than his general hydraulic and economic discussions. For instance, in the two chapters on economics and engineering of water-power development, the author claims that storage for hydro-electric power development reduces the minimum navigable depth of rivers, reduces the ground-water level, and cuts down the crops. For this to happen, it must be dry-season flow that is being impounded instead of the melting snows and unusual rainfalls. Actually, the only ground level reduced is that of early spring and there are over compensating benefits to navigation and agriculture by conserving parts of the flood waters that sweep out to sea, by reducing the devastation of high water, and by distributing river flow more uniformly through the year. This last, incidentally, is the ideal condition for power development.

The commercial value of a waterfall as a scenic display is used as an argument against hydro-electric development. A picture is drawn of a dry Niagara, due to heavy bypassing of water through the plants in dry season. To show such a sad sight, a photograph is reproduced of the Niagara bed unwatered by an ice jam above. Granting that despoiling Niagara would be infamous except in the case of dire necessity in maintaining life, yet why try to argue it in dollars and cents by claiming that the entire annual tourist trade of $20,000,000 would be lost if the beauty of this waterfall fades for two or three weeks in the dry season, just as it has disappeared nearly every winter, of late, through ice jams?

Mr. Bolton defines the most economic utilization of water power as that "by such industries as will utilize the continuous force of the falls for the greatest length of time." This sounds plausible and is true so far as it goes, but it is only a specific statement of a still more basic idea—that the most economic utilization occurs when the total cost of displaced prime power would be a maximum (and above the total cost of delivered hydraulic power). The further argument (based on the pseudo-fundamental idea) that hydro-electric power is not justifiable for the erratic load of personal-comfort and manufacturing service, must therefore fail, if we can determine that enough such services actually exist and will truly cost enough less by transmitted water power, so that the total saving is more than that expected from any and all of the less erratic users. Therefore, it is seen that the author's astonishing statement (page 79) is fallacious, as a broad complete generalization:

"The proposition to convert water power to electrical energy, for the purpose of its conveyance to long distances for general commercial and public purposes, is economically unsound."

That is not all; by a naive multiplication of high loss percentages and low load factors, the efficiency of generation and transmission is made to appear as about 25%—in contrast with the 40 to 60% that has been obtained. The author's idea evidently is that use of peak-load capacity and efficiency of operation are synonymous.

Further on, Mr. Bolton shows that the apparent gain in Ontario by decreased rates, so far, aggregates $652,000 per annum, with a net gain after the deductions for increased cost of street lighting and for sinking-fund payments, of $295,000, or $8 per customer per year. This has required a municipal debt of $14.60 per capita, equivalent to $58.40 per customer benefited. Mr. Bolton argues that this is thoroughly undesirable on broadest economic grounds. Looking at these figures closely, it is seen that the interest on the investment per customer, at 5%, would be only $2.40 per annum, giving an economic gain of $5.60 per annum per customer under the new, compared with the old, situation. It is not that such results as an economic entity are lamentable, but in their individual bearing upon the lives of the citizens—in that the cost of street lighting may have been increased, duplication of facilities permitted, benefits distributed unevenly, and a large public debt created for a service perhaps not demanded by the larger part of the people, together with an unscientific adjustment of rates, which permits of a growing deficit.

Looking at the book as a whole, it would seem that Mr. Bolton had taken the edge from his strictures on the Ontario Commission by his confusing hydraulics and doubtful economics. He would have done better to have stuck to his attack of this instance of municipal operation and not have tried to prove too much.

*See p. 1035 for brief notice of the two latest reports.

River Engineering

RIVERS AND ESTUARIES, OR STREAMS AND TIDES—An Elementary Study. By Henry Hunter, M. Am. Soc. C. E. New York and London: Longmans, Green & Co. Cloth; 6x9 in.; pp. 69; illustrated. $1 net.

European engineers as a class have much more experience in river engineering than have their brothers in the United States, where such problems are the particular province of the Engineer Corps of the Army. This will explain why Mr. Hunter, one of the leading river and harbor engineers of England, has found it desirable to devote much of his valuable time to a series of elementary lectures on river and harbor control to students of engineering and to put more time and energy into the revision of these lectures for the little book which is noted above. So completely has this branch of engineering passed over to the military arm of the profession in America that we doubt if a similar set of lectures would be accepted in the curriculum of an American university. And yet the recent floods in the Middle West have thoroughly demonstrated that the river problem is one of the big ones of this country and one that must eventually be treated on a much larger scale than its present mere application to "navigable" streams, the adjective being a matter of court interpretation.

The introductory chapters of the book refer to the difficulties of the study of rivers and estuaries, attempt certain definitions and explain methods of approach to the examination of any particular river or harbor. The next chapters take up the question of flow, and the final ones describe river and estuarial works, in general and particular, using some of the noted works of the world as examples.

While Mr. Hunter's lectures, and his consequent book, are not applicable to any of these small river problems which are now of such concern to this country, they are so ad-

mirable a brief exposition of the fundamentals of river and estuary hydrology that we wish that they could be in the hands of every technical student in the United States, and further that they could be amplified to meet our own particular troubles. They are in a delightful literary style, complete in the general information they convey and clear in the presentation of that information. The subject is such a large one that a small book can give only the most cursory survey, but Mr. Hunter has made that survey as comprehensive as could be hoped for.

❖

Mechanics

Reviewed by LEWIS E. MOORE*

THE THEORY AND PRACTICE OF MECHANICS—By S. E. Slocum, Professor of Applied Mathematics, University of Cincinnati. New York: Henry Holt & Co. Cloth; 6x9 in.; pp. xiii + 442; 328 text illustrations. $3.

ANALYTICAL MECHANICS—For Students of Physics and Engineering. By Haroutune M. Dadourian, Instructor of Physics, Sheffield Scientific School, Yale University. New York: D. Van Nostrand Co. Cloth; 6x9 in.; pp. xii + 353; 148 text figures. $3, net.

The author's aim in the first of the books before us will perhaps be best understood by quoting the first two paragraphs of the preface as follows:

A course in theoretical mechanics often lacks the strength and vitality resulting from practical applications, whereas a course in applied mechanics is likely to be so technical and limited in its range as to obscure the meaning and scope of the fundamental principles involved. By properly combining theory and practice the efficiency of instruction is greatly increased, and mechanics also becomes a powerful instrument for coördinating mathematics and physics with technology.

In this text the aim is to present the fundamental principles of mechanics in such a way as to emphasize their actual significance and relationship, and at the same time make them a matter of intelligent interest to the average student of junior grade in colleges and universities, and in technical and engineering schools. In each article the explanation is given a body by direct application to some practical problem within the range of the student's experience or understanding.

The first 32 pages are given over to various tables of constants, properties of various plane and geometric figures, tables of logarithms and conversion tables, etc. The first chapter deals with the geometry of motion and the relation between velocities and accelerations in both linear and angular motion and closes with four pages on Kepler's Laws of Planetary Motion. The second chapter begins with Newton's Laws of Motion and follows the relations between mass, force and weight with the principles of work and energy, and impulse and momentum. It closes with a discussion of the units of time, weight and length which are in common use. Chapter 3 is headed "Statics," and takes up center of gravity, moment of inertia, composition and resolution of forces, virtual work, simple structures and flexible cords. Chapter 4 deals with friction and lubrication and would seem to fit better in a book on machine design than it does in one on mechanics. It takes up various types of bearings and of friction surfaces very much in detail both as to construction and computation. Chapter 5 takes up the kinetics of particles, harmonic motion, forced vibration, pendulums and the brachistochrone. Chapter 6 applies the principles of kinetics to solid bodies and treats of least work and transverse vibration in beams. Chapter 7 treats of the dynamics of rotation, flywheels, governors, balancing of engines and the gyroscope.

The book is smoothly written, but is extremely mathematical. The author has so arranged it that the principles of mechanics are subordinated to their mathematical treatment. The definitions throughout are expressed in mathematical language rather than in words, and the statement of principles is also made mathematically. This is unfortunate, as the average student is almost entirely lacking in the ability to translate the meaning of an equation into words. Consequently, in a book in which the treatment is so largely mathematical, the student is apt to gain the idea that mechanics is a branch of mathematics, rather than of natural science. The fundamental conception of the free-body diagram, which is so invaluable as a means of attack for the student, is not mentioned so far as the reviewer could discover. The author's idea is an excellent one, but it is to be regretted that in his treatment he did not lean more to the physical and less to the mathematical side. The book will be found very useful by the teacher of mechanics who wishes to use it as collateral reading in connection with a course which defines more closely the elementary principles and emphasizes them from the physical rather than the mathematical side.

The second of these books is based, as so many textbooks are, upon a course of lectures and recitations which the writer has given, in this case, to a class in electrical engineering. The author has aimed, as stated in the preface, to present the subject in such a manner that the student will acquire a firm grasp of the fundamental principles and learn how to apply them to problems with a minimum amount of mental effort, that is, the author has aimed at economy of thought, but has not reduced the subject to a collection of rules and formulas.

The first chapter takes up the addition and resolution of vector quantities. The second chapter defines a force, and takes up the equilibrium of a particle. On account of the criticisms of Newton's Laws of Motion, which have been made in various quarters, the writer has based his text upon one law which is that "to every action there is an equal and opposite reaction, but the sum of all the actions to which a body or part of a body is subject, at any instant, vanishes." This chapter also takes up statics and kinetic friction and the stresses in strings and certain simple frames. The third chapter treats of motion or translation and rotation in connection with rigid bodies; instantaneous axis, torque, couples, rolling friction and journal friction.

Up to this point the treatment is simple and such as to be readily comprehended by the average student. From this point on it becomes more mathematical. Chapter 4 is headed "The Equilibrium of Flexible Cords." Chapter 5 takes up motion and the various units of force, mass, space and time used in that connection. The author takes up the C. G. S. system and also the British gravitational system, laying rather more stress upon the former than upon the latter, which perhaps is unfortunate in a book to be used by English speaking students. It would seem that his treatment of tangential and normal components of acceleration could have been somewhat simplified. Chapter 6 treats of the motion of a particle, kinetic reactions, the relation between mass and weight, falling bodies and simple harmonic motion. Chapter 7 is devoted to the center of mass and the moment of inertia, which are treated in the usual way. Chapters 8 and 9 are confined to work and energy. Chapter 10 takes up the question of fields of force and Newtonian potential. The next chapter is devoted to the motion of a rigid body in one plane and takes up both transverse and rotary motion. Chapters 12 and 13 treat of impulse and momentum. The treatment is not unusual, but the reviewer's attention was caught by the very simple mathematical demonstration of the reason why a pile-driving hammer should be considerably heavier than the pile. Chapters 14 and 15 take up the motion of a particle in a field of force and periodic motions.

The book contains a large number of good, illustrative problems. The treatment throughout leans more to the physical than to the mathematical side and the book is to be commended in this particular. The subject matter covered does not in general differ greatly from that covered in the usual textbooks on mechanics, and it would seem that the same course could be given from the existing books on the subject, such as Maurer or Church. It is a difficult matter to write a book on the subject of theoretical mechanics which presents the subject in a new way, and the author, while he has succeeded in producing a very creditable textbook, has not varied from what may be called the standard methods of treatment in any appreciable degree.

❖

A French Book on Steam Boilers and Steam Engines

CHAUDIERES A VAPEUR, MACHINES A VAPEUR—By L. Guillot, Professor of Mechanics, National School of Arts and Industries at Angers. Vol. 3, Cours de Mecanique. Paris (France): Ch. Beranger, 15 Rue des Saints-Pères. Cloth; 6x8 in.; pp. 410; 277 figures in the text. 15 francs.

Like other books of this series, this one is of a comprehensive character, dealing chiefly with principles involved and general types of construction. It is largely mathematical in character.

The section dealing with boilers (170 pages) discusses first the production of heat by different fuels, furnaces and draft appliances, and then the production of steam in various types of boilers. There is a chapter on apparatus for feed-water supply and on heating, circulation, mechanical stoking, condensing and superheating.

The section on steam engines opens with a brief historical statement, and a discussion of the mechanical principles of the utilization of steam, including the subject of superheating. It includes reference also to the Stumpf engine, in which the steam flows always in one direction, the exhaust being at the middle of the cylinder instead of at the ends.

*Assistant Professor of Civil Engineering, Massachusetts Institute of Technology, Boston, Mass.

Valves and valve gears in great variety are next considered, and 90 pages are occupied by a geometrical study of steam distribution by various gears. A short chapter is devoted to compound engines, mainly as to their steam economy.

The final chapter (50 pages) deals with steam turbines, which it traces back to de Laval (1883) and Parsons (1884). The main features of several types of machine are described.

❖

Alternating-Current Machinery

Reviewed by ERIC A. LOF*

THE DESIGN OF ALTERNATING-CURRENT MACHINERY—By James R. Barr, A. M. Inst. E. E., Late Lecturer in Electrical Engineering, Heriot-Watt College, Edinburgh, and R. D. Archibald, A. M. Inst. E. E., Head of Electrical Engineering Department, Dundee Technical College. New York: The Macmillan Co. London Whittaker & Co. Cloth; 6x9 in.; pp. xvi + 496; 340 text illustrations and 17 plates. $3.75, net.

Written by the late James R. Barr, this book has been revised for publication by Robert D. Archibald. It is intended to be a companion volume to Mr. Barr's book on "Direct-Current Electrical Engineering," and is primarily intended for designing engineers, although it should prove very useful to any one desiring a more intimate knowledge of this subject.

It does not, as the title would make one believe, cover the whole subject of alternating-current machinery, but merely alternators, transformers and rotary converters. These are, however, covered very comprehensively with an abundance of data and examples relating to the European design of such apparatus.

The book is divided into fifteen chapters, of which seven deal with alternators, three with transformers and three with rotary converters. The first chapter is devoted to the theory of alternating currents and deals with complex wave forms and harmonics, a number of examples on wave-form analysis being given.

The second chapter, and one of the most important of the book, takes up the subject of insulation. This subject has not in the past received the attention which it deserved, but with the rapid increase in high potentials, a great activity is now manifest in the research work on this subject. In the early days of electrical engineering the general practice was to consider only the ohmic or insulating resistance, and that insulating material, which by measurement, gave the highest insulation resistance was regarded as the best. This, however, was a wrong basis on which to make comparisons, because the insulation resistance depends largely upon the moisture contained, and in a given sample can be varied very greatly by simply putting the sample through a prolonged process of baking. The dielectric or disruptive strength of a material, rather than the insulation resistance, is now recognized as the true measurement of its usefulness as an insulator, the dielectric strength depending chiefly upon the molecular structure of the material.

The effect of the potential gradient and of specific inductive capacity upon the disruptive voltage of a compound dielectric is well illustrated and directions of tests for dielectric strength are given; the influence of the shape of the electrodes, mechanical pressure, wave form, frequency, etc., being taken up. The properties of a number of insulating materials, such as mica, pressphan, vulcanized fibers, impregnated paper and cloth, oils and varnishes, etc., are described, a number of curves being given showing the actual disruptive strength of these materials. In addition to this, methods of insulating generator and transformer windings, and thickness of insulation used are shown, and a table gives the usual values of testing voltages adopted by British manufacturers.

The subject of alternator design is covered very thoroughly, almost one-half the contents of the book being devoted to the same. Mechanical construction features of both slow-, medium- and high-speed machines are dealt with. This includes a short paragraph on the ventilation of high-speed turbo-alternators, but nothing is said regarding the provisions which nowadays are made in the design of slow- and medium-speed alternators to insure the best ventilation. This is at the present a very live subject and almost all modern alternators of large size are now constructed so that the path of the ventilating air is controlled and thus the best cooling effect obtained.

The theory of the electrical design is gone into thoroughly, numerous tables and curves being included, giving values of coefficients, etc., obtained from long experience. A large number of examples are also given outlining the procedure of actual designs and tests, while a whole chapter is devoted to the important subject of parallel operation.

*Power and Mining Engineering Department, General Electric Co., Schenectady, N. Y.

The subject of transformers begins with a review of the fundamental principles, the usual transformer diagrams being given. The text deals largely with core-type designs, the reason for this being the fact that this type is mostly used abroad while in this country the opposite is the case, especially for larger sizes. Not much new material has been added to this subject, although remarkable results have been obtained in the last few years, in that transformers are now being built for operating voltages as high as 150,000 volts and in capacities up to 14,000 kv.a. In order to accomplish this a number of novel features have been incorporated in the design, both electrical and mechanical. While formerly a close regulating transformer (one with low inherent reactance) was of prime importance, this is no longer so. Safety to withstand the severe mechanical strains imposed on short-circuits is now the chief consideration and in order to limit these strains to a safe value, the transformers are now generally being designed for much higher reactance than formerly, the regulation being taken care of by automatic voltage regulators. Improved methods of bracing the coils and of insulating the windings, and the provisions made for bringing out the high-tension leads belong also to the most difficult problems in transformer designs which now have been successfully solved, and which would have been an interesting addition to the matter covered in this book.

The chapters on rotary converters should be well received, as comparatively little has been written in English on the design of this type of machinery. The fundamental principles are described, including the transformation ratios and the factors which affect these ratios. The subjects of armature reaction, heating and output are also briefly covered, as is the subject of voltage regulation, although this latter should have been gone into more thoroughly. For example, nothing is said about the regulating-pole converter, which is now being successfully used to a very great extent in this country for variable voltage work.

A reference to the commutating-pole converter might also have been interesting, this type, with its large overload capacity, now being used to the greatest extent where the load is apt to fluctuate greatly, such as for railway work.

The subject of rotary converters ends up with an actual example of a design of a compound-wound machine.

Fifteen large plates are included with the book, showing construction of different types of alternators, transformers and converters of European design.

While the book undoubtedly will be of value to designing engineers, it can hardly be considered as good as some of the books which have recently been published in this country on similar subjects.

❖

"The Need for a National Budget" and "A Budget for the Fiscal Year 1914," are the titles of two important recent Congressional documents (House No. 854, June 27, 1912, and Senate No. 1113, Feb. 26, 1913). Officially, the contents of each volume is a message from ex-President Taft to Congress, with supporting documents embodying a portion of the work done during the past two years or so by the President's Commission on Economy and Efficiency, of which F. A. Cleveland is chairman.

The first volume is a valuable monograph on the Budget in general and the need of the United States for one in particular. It shows how the United States has muddled along for a century and a quarter without a budget and what a valuable aid to economy, efficiency and administrative control a budget would be. Foreign budgetary practice is reviewed.

The second volume, as the title indicates, submits a real budget for the fiscal year 1914. As this budget was transmitted to Congress only a week before its final adjournment it was, of course, too late for action by that body.

We understand that there is good reason to expect that President Wilson, when the proper time comes, will support the federal-budget plan as heartily as did ex-President Taft. It is to be hoped that Congress will sanction the plan, so we shall no longer witness the spectacle of annual appropriations of a billion dollars being put through Congress piecemeal, in separate bills uncorrelated with each other or with available revenue, and with no adequate means of comparing appropriations with past expenditures, nor either of these two with the actual needs of the country, and with absolutely no means of testing the efficiency with which funds appropriated are expended. The United States, of all the civilized countries in the world, stands alone in this respect.

❖

OIL AND GAS WELLS THROUGH WORKABLE COAL BEDS—Papers and Discussions. By George S. Rice, O. P. Hood and others. Washington, D. C.: Bureau of Mines. Paper; 6x9 in.; pp. 101; illustrated.

In discussing methods of protecting bore-holes for pur-

poses of safety, a number of sectional drawings are given to show how concrete may be used for sealing casings. Regulations for the protection of coal beds are suggested.

Overhaul

Reviewed by S. S. ROBERTS*

EARTHWORK HAUL AND OVERHAUL, Including Economic Distribution—By J. C. L. Fish, M. Am. Soc. C. E., Sometime Division Engineer, Lake Shore & Michigan Southern Railway; Professor of Railroad Engineering, Leland Stanford, Junior, University. New York: John Wiley & Sons. London: Chapman & Hall, Ltd. Cloth; 6x9 in.; pp. xiv + 165; 66 text figures. $1.50 (6/6), net.

Mr. Fish presents a comprehensive résumé of much of the literature on overhaul. The book is interspersed with numerous explanatory diagrams, and deals with the subject from the primary definition of haul to the application of the "economic haul distance" in the determination of proper distribution.

Three bases, or theories, for the computation of overhaul are demonstrated. Preference is given to the one set forth in the "Manual of Recommended Practice" of the American Railway Engineering Association (1911), as incorporated in the "Specifications for the Formation of the Roadway," under optional clause 48-a.† After the exposition of this basis, no other premise is considered. Under it eight methods of computing overhaul for a simple case, and five methods for a more complex condition are minutely analyzed and illustrated. Diagrams and a reproduction of a profile of work actually performed are used. The results are tabulated, showing the total overhaul given by each procedure, the difference in "station cu.yd." (cu.yd. hauled 100 ft.) and a comparison of the percentage of relative probable error.

Consideration is given to the accuracy of method consistent with the necessarily approximate cross-section data and the uncertainty of behavior of excavated material. Finally inferences are drawn as to the time and method justifiable in overhaul computations. The last three chapters of the book explain the "economic haul distance"; its application in connection with balancing lines and the mass diagram, or profile, to determine economic distribution.

The author quotes or refers to articles and publications by Allen, Fisher, Gillette, Molitor & Beard, Prelini, Raymond, Russel, Searles, Webb, "Engineering News," and the American Railway Engineering Association. There is nothing new or previously unpublished in the book, unless it is the idea of swell in excavated material reduced to swell and equating factors, which are employed to keep the balancing line always horizontal or level. The expediency of this refinement may be questioned by many; especially in preconstruction investigations. During construction, an experienced engineer will require the keeping of as full and accurate records of actual distribution of material as possible and will adjust overhaul computations accordingly. The author states in substance, all things considered, computation of overhaul by means of the mass diagram gives results within the limit of accuracy of the field data.

The unforseen and indeterminate exigencies of construction, such as unusual weather conditions, delay in completion of certain controlling structures, injunctions, change of line or grade, and even character of equipment, may materially derange of practically destroy any prearranged scheme of distribution. Therefore, without depreciating the value of distribution study, the less elaborate explanations and methods of some of the other authors, above mentioned, will generally prove satisfactory and sufficient for the requirements of practice. Molitor & Beard's method of computing overhaul and Raymond's explanation of the mass diagram and its uses, give the succinct meat of the subject.

Mr. Fish's demonstrations are clear. Under his assumptions his reasoning and equations are correct. He gives both methods, where swell is considered and where it is not. His book as a treatise on its subject should prove a useful and valuable work of reference. To the reviewer there seem to be many repetitions of details and some near repetition of subject matter. The volume of the book might be reduced one-half by the rearrangement of some parts and the elimination of others without diminution of scope or usefulness.

As the book is, it brings out many more points in overhaul than many engineers at first thought might believe to exist.

*Howard & Roberts, Civil and Consulting Engineers, Chicago.

†No payment shall be made for hauling material when the length of haul does not exceed the limit of free haul, which shall be ———— ft.

The limits of free haul shall be determined by fixing on the profile two points (one on each side of the neutral grade point), one in excavation and the other in embankment, such that the distance between them shall equal the specified free-haul limit and the included quantities of excavation, and embankment balance. All haul on material beyond this free-haul limit shall be estimated and paid for on the basis of the following method of computation:

All material within this limit of free haul shall be eliminated from further consideration.

The distance between the center of gravity of the remaining mass of excavation and center of gravity of the resulting embankment, less the limit of free haul as above described, shall be the length of overhaul; and the compensation to be rendered therefor shall be determined by multiplying the yardage in the remaining mass, as above described, by the length of the overhaul. Payment of the same shall be by units of 1 cu.yd. hauled 100 ft.

Where material is obtained from borrow pits along the embankment and runways are constructed, the haul shall be determined by the distance the team necessarily travels. The overhaul on material thus hauled shall be determined by multiplying the yardage so hauled by half the round distance made by the team, less the free-haul distance. The runways shall be established by the engineer.

BUILDING CONSTRUCTION—By John H. Markham, Edwin Gunn, Alan G. James, Herbert A. Satchell, F. M. Simpson and J. D. Crace. Vol. II. [Being part of The Architects' Library.] New York and London: Longmans, Green & Co. Cloth; 6x9 in.; pp. ix + 360; 142 text illustrations. $4 (10/6), net.

The first volume of the series, of which the book before us is the second and last, was entitled "Building Construction" and was reviewed in the Engineering Literature supplement of "Engineering News," Mar. 16, 1911, p. 40. As stated then, the series is intended primarily for architects, and as such glosses over a number of points of design, particularly the mathematical analyses, which are required and desired by engineers. The second and last volume is devoted about equally to reinforced concrete and to the general treatment of the various fittings and finishings to buildings.

The reinforced-concrete portion, written by John H. Markham, is conventional in the treatment of the subject, making allowances for the more complicated methods at present in use in England. The succeeding portions are of more direct interest to American constructors, particularly of the architectural persuasion rather than the engineering. They are, briefly, sections on roof coverings, which include slate, tile, stone plate and hatches, by Edwin Gunn; external plumbing, which includes leads, flats, gutters, joints, etc., by Alan G. James; glazing, by John H. Markham; timber, mostly an exposition of the various building woods used in Great Britain, by H. A. Satchell; carpentry (called "joinery" in the book), by F. M. Simpson; plastering, by John H. Markham, and painting and decoration, by J. D. Crace. In the details of building fittings the European countries have the great advantage of many years of work, and American practitioners can gain much by studying the methods in use there. Next to studying these methods first-hand, the best thing is to get them from a well written book, such as the second volume of this "Architect's Library."

CITY OF NEW YORK DEPARTMENT OF WATER-SUPPLY, GAS AND ELECTRICITY—Report on the Work Done for the Prevention of Water Waste, Cost of the Same and Results Accomplished Thereby (Oct. 1, 1912). Henry S. Thompson, Commissioner, 13 Park Row. Paper; 6x9 in.; pp. 35; illustrated.

Tells how 33,500,000,000 gal. of water were saved in Manhattan and the Bronx at a total expense of about $138,000, not allowing for $29,000 fines imposed. The saving was effected by house-to-house inspection, and its amount was estimated by pitometer gagings before and after district inspections. The portion of the work done in 1911, tided the city over a remarkable period of low rainfall (June, 1910, to August, 1911, lowest recorded for same period in 43 years). As a result of the work as a whole the water consumption of New York City was reduced to 101 gal. per capita. The work was done under I. M. de Varona, chief engineer, Bureau of Water-Supply, and Henry S. Thompson, Commissioner of the Department of Water-Supply, Gas and Electricity.

SPECIFICATIONS FOR THE DESIGN, CONSTRUCTION AND OPERATION OF EXHAUST SYSTEMS FOR GRINDING, POLISHING AND BUFFING WHEELS—By William Newell, Mechanical Engineer, New York State Department of Labor, 381 Fourth Ave., New York City. Paper, 4x7 in.; pp. 8; illustrated.

In the preface to these specifications Mr. Newell explains that the department of which he is engineer has found that in very many cases exhaust systems in grinding and polishing rooms are so installed as to be ineffective for their work and to allow the room to become filled with dust, to the injury of the workmen's health. Such defective work is due more to ignorance than to intention. It costs very little more in designing an exhaust system to make it so that it will properly do its work and effectively remove the flying

dust and grit. These specifications are published for free distribution to encourage the installation of dust-removal systems in such a manner that they will work effectively.

❖

Precise Measurements

Reviewed by N. E. DORSEY*

ELEMENTS OF THE PRECISION OF MEASUREMENTS AND GRAPHICAL METHODS—By H. M. Goodwin, Professor of Physics, Massachusetts Institute of Technology. New York and London: McGraw-Hill Book Co. Cloth; 6x9 in.; pp. 104; illustrated. $1.25, net.

The author states that this book, which consists of three parts and an appendix of useful tables, is intended for students who are in the middle of their sophomore year and "have performed some six or eight experiments on fundamental measurements in Mechanics." He also says, "that the method of treatment has been kept as brief as possible."

Part I treats of the Precision of Measurements. Here errors are classified and described, the distribution of accidental errors is briefly considered, the formulas for computing the various deviation and precision measures are given and are applied to specific problems, the weighting of observations is discussed, and rules are given for the rejection of observations and of superfluous figures. For a more complete treatment of the subject and for the derivation of the formulas given, the student is referred to Holman's "Precision of Measurements" and to Bartlett's "Method of Least Squares," of which this part is essentially an abbreviation.

The notation and terminology are those used in the works just mentioned. To the reviewer, the terminology of this subject, by whomever treated, appears rather unsatisfactory. In the present case he cannot help wondering what physical significance the unassisted student will attach to the expression "deviation of the mean" as applied to the mean of a single set of observations. The difficulty is not reduced by the use of the abbreviation A. D., which, by analogy, suggests average deviation of the mean.

Fig. 1, which represents the observed distribution of shots in a certain target, and is taken directly from Bartlett, is an excellent illustration of the effect both of constant and of accidental errors. In not calling attention to the constant error involved and to the consequent shifting that is necessary in order to make the curve of error fit the observations, both authors seem to have failed to make full use of the figure. The statement that this figure indicates that plus and minus deviations are about equally frequent will scarcely be accepted by the thoughtful student.

Part II deals with Graphical Methods and is probably the most useful portion of the book. After a general discussion of the points that must be considered in order to obtain the most useful plot, the algebraic representation of a straight-line graph is considered. Then follow methods for the rectification of the graphs of trigonometric, reciprocal and logarithmic functions, with examples. It is probable that the unaided student will be mystified by the unerring precision with which the general shape of the curve "suggests" to the author the form of the function which best fits it.

The residual plot, interpolation formulas, and the construction and use of "normal equations" are also briefly considered.

In Part III are given 79 problems involving the methods discussed in the preceding parts. These are preceded by a detailed solution of four illustrative problems.

The book contains in a small compass much information and advice that will be of use to those engaged in experi-

---

STEAM BOILERS, THEIR THEORY AND DESIGN—By H. deB. Parsons, M. Am. Soc. M. E., M. Am. Soc. C. E., Professor Emeritus of Practical Engineering, Rensselaer Polytechnic Institute. Fourth edition. New York and London: Longmans, Green & Co. Cloth; 6x9 in.; pp. xvii + 377; 156 text illustrations. $4 net.

The time was when Prof. Parsons' book on Steam Boilers was regarded by many teachers and students as the last word in boiler treatises. It was a concise summary of underlying theory, a clear exposition of the phenomena involved, and a compendium of latest practice and important data.

The fourth edition now at hand, being little more than a reprint of the earliest edition, preserves unimpaired the value of all the theoretical discussions and much of the description. But the revision has been so slight that necessarily it cannot be regarded as wholly modern in its treatment of some apparatus, or in its tables of performance data, or in its references.

*Associate Physicist, Bureau of Standards, Washington, D. C.

The most notable additions are (1) a full-page familiar diagram showing the relative distribution of heat losses in a steam-power plant, (2) a new steam table—reprinted from the Marks and Davis book of tables, (3) a few foot notes calling attention to recent articles in technical journals, etc.

❖

Hydraulic Diagrams

Reviewed by JOHN H. GREGORY*

DIAGRAMS FOR THE SOLUTION OF THE KUTTER AND BAZIN FORMULAE FOR THE FLOW OF WATER—Prepared by Karl R. Kennison, 815 Grosvenor Bldg., Providence, R. I. Paper; 8x11 in.; pp. 4. $1.

This small pamphlet contains two pages of text and two diagrams for solving certain classes of problems relating to the flow of water. One diagram is based on Kutter's formula and the other on the Bazin formula. Given any three of the four variables, velocity, slope, hydraulic radius and coefficient of roughness, the fourth can be obtained from the diagrams. For solving special problems these diagrams will be found of much service but they are not especially well adapted for solving quickly the ordinary problems relating to the flow of water in pipes or circular conduits. Scales are given on the diagrams so that metric as well as English units can be used.

PROVINCE OF ONTARIO HYDRO-ELECTRIC POWER COMMISSION—Third and Fourth Annual Reports for Year Ended Oct. 31, 1911. Toronto: W. W. Pope, Secretary. Paper; 6x10 in.; pp. 327; illustrated.

The third and fourth annual reports of the Hydro-Electric Power Commission of the Province of Ontario, bringing the account of this great project up to Oct. 31, 1911, has recently been received bearing a 1912 imprint. This is a large volume which contains the legislative acts of 1910 and 1911 affecting the commission, and the various agreements made for the purchase and sale of power. There is an account of the construction work done on the Niagara transmission project, and abstracts of the innumerable hydraulic investigations made for various towns and cities in regard to the feasibility of local power developments. As this report fails to bring authentic details of the Commission schemes at all up to date, one will look in vain for that illuminating data on cost of construction or operation which is so much desired in view of the recent charges of deficits and taxpayers' burdens on the 200-mile transmission line now in service out from Niagara.

CENTRAL PURCHASE AND DISTRIBUTION OF SUPPLIES FOR THE CITY OF NEW YORK, Together with All the Forms Necessary to Carry the System into Full Operation and Effect—Report of William A. Prendergast, Comptroller, 280 Broadway. Paper; 8x11 in.; pp. 72; illustrated.

Outlines a plan under which the mayor, comptroller and the president of the Board of Aldermen would become a Board of Purchase and a general purchasing agent and a general storekeeper would be chosen, with coördinate powers, subject to the Board of Purchase. The purchasing agents of the 18 largest city departments would work conjointly with the general purchasing agent, so far as supplies for their own department are concerned. It is estimated that the plan would effect a saving of $3,000,000 to $4,000,000 a year for New York City. The plan is modeled on the one in use by the Canadian Pacific Ry. Various blank forms for putting the plan into effect are included in the report.

MASSACHUSETTS STATE INSPECTORS OF HEALTH—Fifth Annual Report (1911). Boston, Mass.: State Board of Health. Paper; 6x9 in.; pp. 84; illustrated.

The work of the 14 State Inspectors of Health is summarized by its character rather than by the 14 districts into which the state is divided. The inspectors are physicians and it is pleasing to note that nearly all of them have served since 1907, the year when the service was started. Among other subjects, the inspectors deal with communicable diseases, nuisances, water-supply and sewerage, factories and workshops, laundries and slaughterhouses.

BIRTH REGISTRATION—Monograph No. 1, Children's Bureau (Washington, D. C.). Paper; 6x9 in.; pp. 24.

Only eight states (the six New England, Pennsylvania and Michigan) have sufficiently complete registration of births to bring them within the birth-registration area. Of the other states, 16 have enacted legislation, 20 need either new laws

*Consulting Engineer and Sanitary Expert, 170 Broadway, New York.

or important amendments to old ones and Arkansas, Georgia, North Carolina and South Carolina have no laws for birth registration. The importance of birth registration is explained in this monograph and a model registration law is given.

❖

Consolidation of Two Machine-Design Texts

Reviewed by JOHN J. FLATHER*

MACHINE DESIGN—By Charles H. Benjamin, Dean of Schools of Engineering, Purdue University, and James D. Hoffman, Professor of Mechanical Engineering and Practical Mathematics, University of Nebraska. New York: Henry Holt & Co. Cloth; 6x9 in.; pp. x+342; 205 text illustrations. $3.

The present book represents the consolidation of two texts on this subject, Benjamin's Machine Design and Hoffman's Elementary Machine Design. As now arranged, the book serves a twofold purpose. It may be used as a text for classroom work embodying the theory and practice of design, or it may be used as a reference book in the drafting room, illustrating the design of complete machines.

An examination of the text shows that it covers a wide range of subjects which include practically all of the topics which previously appeared in the separate texts, to which has been added much additional matter. The chapter on materials has been rewritten and the work on cast-iron frames, which has always been a commendable feature, has been greatly augmented; in this portion of the work and elsewhere experimental data obtained by the authors and others are given in support of the principles deduced. The theoretical and experimental strength of steel tubes under collapsing pressures is quite fully discussed and additional data are presented on the failure of pipe fittings. Other subjects which receive fuller treatment in this volume than heretofore are flat plates, crane hooks, leaf springs, bearings, both plain and rolling, clutches, gear teeth and belting.

The material given in that part of the book between pages 235 and 309, which relates to the design of particular devices and machines, offers the student an excellent opportunity for acquiring proficiency in analytical methods of attack. There are to be found logical presentations of the design of simple machines, such as toggle-joint presses; this is followed by the design of punch presses, bevel and rotary shears and similar machines; then follow typical designs of air hoists and various forms of pneumatic and hydraulic riveters.

The concluding chapter of the book consists of studies in the Kinematics of Machines, which treat very briefly gear tooth outlines, cams, quick return motions; motion problems; mechanism of governors and the Stephenson and Walschaert valve gears. It would seem to the present reviewer that the thirty pages included in this portion of the work does not properly belong to the subject of machine design and should not have been given space in the present book. The subject matter and methods of presentation are sufficiently valuable to warrant a more elaborate treatment and publication in a separate volume.

The scope of the present volume will be seen from the following captions: Materials; Frame Design; Cylinders and Pipes; Fastenings; Springs; Sliding Bearings; Journals, Pivots and Bearings; Ball and Roller Bearings; Shafting, Couplings and Hangers; Gears; Pulleys and Cranks; Flywheels; Transmission by Belts and Ropes; Design of Toggle-Joint Press; Design of Belt-Driven Punch or Shear; Design of Air Hoist and Riveter; Studies in the Kinematics of Machines.

❖

One of our London contemporaries, "The Surveyor and Municipal and County Engineer," carries these lines at the head of its Correspondence columns each week:

For every ill beneath the sun
There is some remedy or none;
If there be one, resolve to find it;
If not, submit, and never mind it.
—Anon., circa 1843.

Either the same or another London paper devoted to municipal public works used to run this couplet in the same position:

One man's word is no man's word,
Justice is that both be heard.

❖

"The Wood Preserving World," a monthly journal to be devoted exclusively to wood preservation and wood block paving, made its first appearance in April, 1913. It is published in Minneapolis, Minn., and W. E. Wadsworth is given as business manager, and W. F. Goltra as contributing editor. The first number has very little original matter in it, but has the value of collecting between two covers matter all on the same subject.

❖

Long-Distance Instruction in Steam Engineering

STEAM BOILERS—Prepared in the Extension Division of the University of Wisconsin by E. M. Shealy, Assistant Professor of Steam Engineering. New York and London: McGraw-Hill Book Co. Cloth; 6x9½ in.; pp. xiv + 356; 185 text illustrations. $2.50, net.

A textbook on boilers, with no mention of thermodynamics! If anyone doubts that a college teacher can come down from the clouds and plant his feet firmly on the earth, he would do well to read this book, which is intended as an instruction text in the extension courses of the University of Wisconsin. This work is largely carried on through correspondence. The men it is intended to help with this particular volume are the mechanics in the power plants. The book does not contain a single thermodynamic bugbear, and the adjective itself, a by-word on the college campus, is not seen.

The text is forcible, clear, and concise. The ground is well covered in a general way, though there are a few details in the way of specific apparatus and construction which might have been added, had completeness been desired. As one such, might be mentioned the Jacobs-Shupert stayless locomotive firebox, which ought to interest every fireman because of its novel construction and proven utility.

Many of the cuts are of catalog type, but as the text is admittedly descriptive of commercial practice, it might be finicky to object to them here. The author is to be commended for even briefly discussing the danger which exists with lap and single-strap butt joints, through the distortion produced by internal pressure. It would have been well, perhaps, had he even gone further and shown how the elastic limit is exceeded in the outer fibers of a plate at these joints, and how this may set up secondary deterioration by stimulating local corrosion.

To some engineers it will seem that the author has laid perhaps undue stress on the production of smoke by chilling the combustion-chamber walls. It has been shown that a certain amount of chilling does not materially increase the production of smoke and has a very appreciable effect in increasing the efficiency of operation. Tests have shown that the greater part of the total absorption of heat in a boiler comes from the energy radiation of the incandescent fuel bed; therefore it is wise to intercept this radiation by water-cooled metal surfaces, taking care, however, that the combustion space is still large enough so that excessive chilling is prevented.

A set of simplified steam tables is included in the book, but no mention is made of the source of the values. They do not check closely with the latest tables, like Marks and Davis', or with the revised Peabody tables, which are built up from the same fundamental data. They check closer with the older tables now generally discarded. The differences are small, however, and for the purposes of this book will cut no figure wherever employed.

The book does not confine itself entirely to boilers, for after it has outlined the different types and constructions in general and to considerable detail, it discusses the relations of heat and work (non-mathematically), the effect of heat, the properties of steam, the characteristics of available fuels, the processes of combustion, the better methods of firing as contrasted with the poorer, the factors which promote a smokeless combustion of coal, boiler auxiliaries and fittings, the construction of chimneys and the computation of draft, the production of artificial draft, the composition of boiler feed water, the inspection and care of boilers and auxiliaries.

❖

The Chicago Municipal Reference Library, will be operated hereafter as a branch of the Public Library of that city. The following statement regarding this and other municipal reference libraries is by Frederick Rex, Municipal Reference Librarian of Chicago.

The Chicago Municipal Reference Library is similar in purpose to the libraries of this character established in the cities of Baltimore, Kansas City, Milwaukee, Minneapolis and St. Louis. It is engaged in collecting, indexing and preserving all data obtainable relative to the operation and government of municipalities, such as reports, ordinances, statistics, books, bills, documents and magazines. This material, while chiefly intended for municipal officials, is also available to

*Professor of Mechanical Engineering, University of Minnesota, Minneapolis, Minn.

any citizen, civic organization, representative of the press, and all who desire information on any function or phase of city government. It is located in room 1005, City Hall.

❖

The Railway Spiral

Reviewed by W. W. COLPITTS*

THE PRACTICAL RAILWAY SPIRAL—With Short Working Formulas and Full Tables of Deflection Angles: Complete Notes of Illustrative Examples. By L. C. Jordan, Principal of Civil Engineering Department, Heffley Institute, Brooklyn, N. Y. New York: D. Van Nostrand Co. Flexible leather; 4x7 in.; pp. viii+155; illustrated. $1.50, net.

The appearance of a new "Railway Spiral" is not likely to be met with immediate enthusiasm. Railroad engineers, in fact, have felt that the subject has already been over developed. It is not very long ago that spirals of any kind were regarded as an extreme refinement and on many of the older lines the curves are still without easement ends, except to the extent that they may have been crudely introduced by the section foremen. In latter years, however, with higher speeds and more rigid demands for comfort in travel, the spiral has become a real necessity. Because of the many practical limitations no form of spiral can attain scientific perfection even for fixed conditions of speed, though many have approximated theoretical requirements very closely.

The spiral devised by Professor Jordan may fairly be said to approach a step nearer theoretical perfection than any other in that the cubic parabola on which it, like many others, is based, is itself spiraled. The curve is designed to meet the practical conditions of the field for easy application and the tables are completely elaborated for rapid calculation. Appended to the book are the usual mathematical tables in convenient form.

In view of the large amount of railroad construction in Latin America it is believed that the book would have much wider usefulness were the tables and formulas converted to the metric system. The book is small, compact and well bound in morroco—features that commend it to the field man.

❖

SCHUBWIDERSTAND UND VERBUND IN EISENBETON-BALKEN auf Grund von Versuch und Erfahrung—By R. Saliger, ord. Professor der k. k. Technischen Hochschule in Wien. Berlin: Julius Springer. Paper; 8x11 in.; pp. 66; 139 text figures. 5 Marks.

The question of shear resistance and bond stress in reinforced-concrete beams offers just as large a field for experimentation as for theoretical discussion. The difficulty of getting satisfactory results from experimental study of shear and bond makes all experiments on the subject valuable, since they add to the number of individual results and thus increase the reliability of the grand average. Mr. Saliger makes a notable contribution. He concludes:

Beam strength is limited by the yield-point strength of the steel, not by its ultimate strength. To secure adequate shear resistance, bent-up rods will suffice if they are at least 70% of the tension steel and if spaced closer than twice the beam lever-arm. Stirrups increase bond strength and shear resistance, by taking up tensile stresses not otherwise adequately resisted. Bond strength is greater with small than with large rods. Anchorage, hooping of beam ends, etc., keep the rods in action even after slip of the steel. If the reinforcing steel of a beam is properly arranged and distributed, the bond strength is adequate if the rod diameter is less than 0.006 to 0.008 of the span.

These dicta may not contain very novel matter; but even their confirmation of prior impressions or conclusions will be welcome, if borne out by the tests themselves. The book must be studied for the details.

❖

STRUCTURAL DETAILS OF HIP AND VALLEY RAFTERS—By Carlton Thomas Bishop, Assistant Professor of Civil Engineering, Sheffield Scientific School, Yale University. New York: John Wiley & Sons. London: Chapman & Hall, Ltd. Cloth; 10x8 in.; pp. v+72; 43 text figures. $1.75, net (7/6, net).

HIP AND VALLEY DESIGN. DETAILS, FORMULAE AND GRAPHICS; ROOFS, HOPPERS AND PIPE LINES—By H. L. McKibben and L. E. Gray, Engineers with American Bridge Co. Edited and published by J. E. Banks [Engineer, Bureau of Standards], American Bridge Co., Ambridge, Penn. Stiff paper; 7x9 in.; pp. 30. $2, postpaid.

Both books record the methods and formulas required for detailing hip or valley framing in steel roof structures, i.e., for finding the angles or distances between the various lines and planes involved in the skew details. The two books differ in various ways, while both are closely adapted to the daily needs of the detailer and draftsman.

The work of McKibben and Gray appears to represent the American Bridge Co. in some way. Photographic views are shown of three types of connection of purlins to flange of hip, and two types of connection to web of hip; in the text the graphic layouts and the formulas for these cases are given, separately for hips and valleys; and there are tables, collections of formulas, etc., and the solutions for hopper problems and for bends of inclined pipes. The style is very condensed, notebook fashion. Prof. Bishop's book groups the principal cases of connections under the two headings Flange Connections and Web Connections, but under these heads he subdivides rather minutely. He covers the general derivation of formulas and the graphic determination of angles in separate chapters. The book is essentially more scholarly than the other, but does not for that reason have less practical value.

The reader's preference for one or the other book will depend largely on temperamental differences. The meat of the matter of skew roofwork is well presented in each.

❖

"Financial Statistics of Cities Having a Population of Over 30,000"for the financial year 1910, have just been issued by the U. S. Bureau of the Census (Washington, D. C.), under the supervision of Le Grand Powers, chief statistician for Finance and Municipal Statistics. The similar publication for 1909 appeared earlier in the present year. Each volume comprises about three hundred 9x12-in. pages, of which about a third are devoted to text and brief summary tables and the balance to detailed statistics for each city. The 1910 report covers 184 cities as against 157 in the volume for 1909, the 27 accessions following the 1910 census returns. The 1910 report is the ninth annual volume in this series, which was preceded by a less extensive yearly publication issued for a number of years by the Commissioner of Labor. It is a great pity that statistics like those given in these 1909 and 1910 reports should not appear until 1913. A large part of the delay in the present case was due t ocauses wholly beyond the control of the Census Bureau, chief among which, we understand, was the failure of Congress to supply money to prosecute the work. Before this failure occurred, we have been informed, the Bureau was gradually bringing these publications as nearly uptodate as could reasonably be expected.

PUBLICATIONS RECEIVED

[So far as possible the name of each publisher of books or pamphlets listed in these columns is given in each entry. If the book or pamphlet is for sale and the price is known by the editor the price is stated in each entry. Where no price is given it does not necessarily follow that the book or pamphlet can be obtained without cost. Many, but not all, of the pamphlets, however, can be secured without cost, at least by inclosing postage. Persons who are in doubt as to the means to be pursued to obtain copies of the publications listed in these columns should apply for information to the stated publisher, or in case of books or papers privately printed, then to the author or other person indicated in the notice.]

AARDEN RESERVOIRDAMMEN—By A. A. Meyers, Ingenieur der le klasse bij den Waterstaat in Nederlandsch-Indie. Bijlage van het Archief voor de Suiker-industrie in Nederlandsch-Indie. Batavia, Nederlandsch-Indie: Algemeen Sundicaat van Suikerfabrikanten. Cardboard; 7x10 in.; pp. vii — 90; 45 illustrations.

A pretty full study of earth dams is summarized in this book. English (Indian) and American experience furnished practically all the material for the study. Seen from an outside standpoint, the chief features of American practice are perhaps judged more impartially than by our own authors. Those who have a command of Dutch will find the book worth their while.

AIR COMPRESSION AND TRANSMISSION—By H. J. Thorkelson, Associate Professor of Steam and Gas Engineering, University of Wisconsin. New York and London: McGraw-Hill Book Co. Cloth; 6x9 in.; pp. xiii+207; 143 text illustrations. $2, net.

AMERICAN RAILWAY BRIDGE AND BUILDING ASSOCIATION—Proceedings of 22d Annual Convention, 1912. Chicago, Ill.: C. A. Lichty, Secretary, 226 W. Jackson Boulevard. Paper; 6x9 in.; pp. 295; illustrated.

AMERICAN TELEGRAPH PRACTICE—A Complete Technical Course in Modern Telegraphy, including Simultaneous Telegraphy and Telephony. By Donald McNichol, A. M., Am. Inst. E. E., Member of Engineering Staff, Postal Telegraph-Cable Co., of New York. New York and London: McGraw-Hill Book Co. Cloth; 6x9 in.; pp. xvi+507; 421 text illustrations. $4, net.

ASPHALT CONSTRUCTION FOR PAVEMENTS AND HIGHWAYS—A Pocket-Book for Engineers, Contractors and Inspectors. By Clifford Richardson, M. Am. Soc. C. E.

---

*Vice-President, W. H. Coverdale & Co., 66 Broadway, New York City.